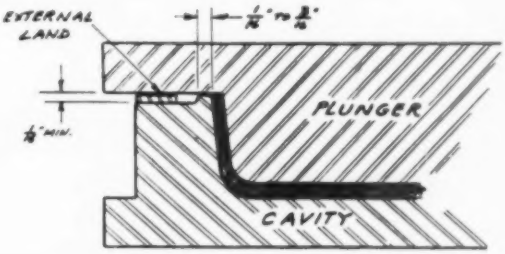
OCTOBER 1959

PLASTICS TECHNOLOGY

THE MAGAZINE OF APPLIED ENGINEERING

Mold Design for Premix



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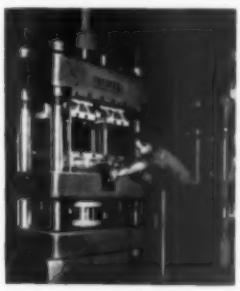

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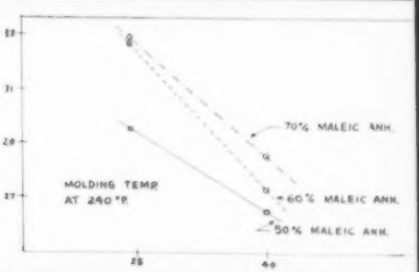

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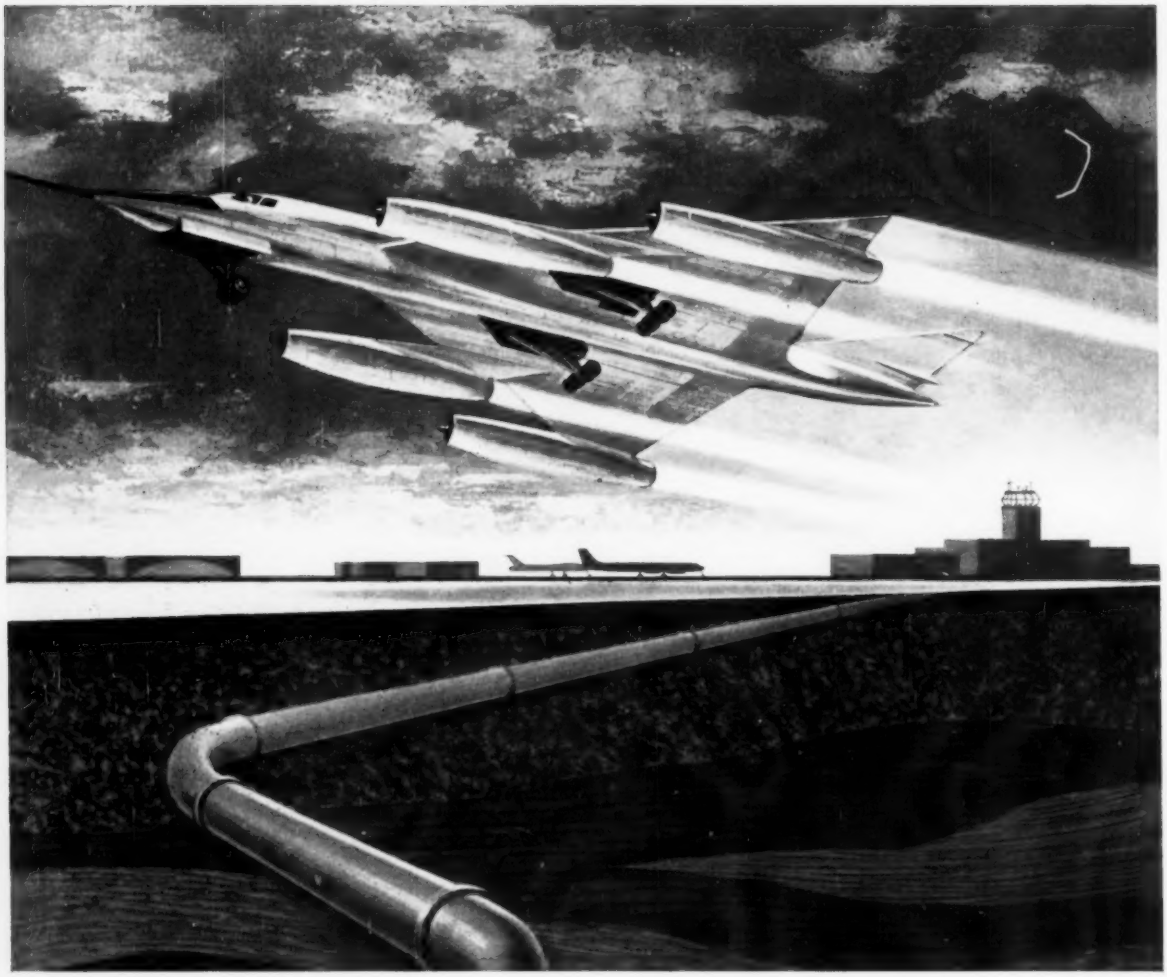

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New and appropriate for the deep-sea yachtsman . . . or the dry-land nautical dreamer . . . is a line of cocktail tables by BoMyte*, with tops laminated to display any U.S. Coast and Geodetic Survey map of one's favorite stretch of shore line.

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Like an authoritative chart to safe ocean channels, the list of Catalin products is a good map to follow whenever your own product calls for the use of an industrial resin. It includes the widest range of urea, phenolic, cresylic, acrylic, resorcinol and melamine resin formulations . . . for improving the wet strength of paper, the finish of textiles and leather, the adhesion of wood, the quality of paint and processability of rubber. As bonding, impregnating and laminating resins, these water and heat resistant formulations increase the service life and properties of industrial and decorative laminates, abrasive and frictional elements, mineral fibre insulations, cork, and foundry shell molds and cores. Samples, spec sheets and technical assistance are yours for the asking. Inquiries invited.

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PLASTICS

THE MAGAZINE OF APPLIED ENGINEERING

TECHNOLOGY

October 1959, V. 5, No. 10

feature articles:

mold design for premix p. 33

by H. J. DUPREZ

By comparing standard design techniques used to make molds for molding premix materials, it is possible to visualize the tooling advantages found with these materials. Mold design and fabrication techniques are described for molding at a cost consistent with production rate and volume requirements.

a study of compression molding pressures p. 38

by D. A. DEARLE

Excessive or inadequate molding pressures can effect the suitability of resultant molded parts, and the life expectancy and durability of the compression presses themselves. The problems involved with the major types of compression presses are described, and the use of accumulators is discussed. Equations and their use in calculating the proper pressures are given.

thermoforming biaxially-oriented film and sheet p. 42

by J. L. MURPHY

Dominant variables that contribute to improper vacuum forming of oriented sheet and film include sheet clamping, heat equalization, mold temperature, cycle timing, drape speed, and adequate vacuum. The importance of each is described, and information is given on recent developments in forming equipment and product design.

effects of molding variables on reinforced-plastic products p. 45

by T. H. BEALS, T. G. TAN and C. B. SIAS

In an extensive series of tests made on glass-polyester parts molded in matched-metal molds, the most important variables readily controllable by the molder were shown to be styrene content of the resin, reactivity of the resin, and molding temperature. The best-appearing moldings tested were cured at 260° F., using the highest-reactivity resin (70% maleic) at the lower styrene content (25%).

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The trained personnel problem in blow-molding.

injection molding p. 55

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Photo courtesy Bednunster Sound Corp., Belleville, N. J.

Now, hear this—for stereo with better audio!

There can be no compromise with quality when you're working with stereo. Reason: the buyer of a stereo record *expects* the ultimate in sound reproduction. He expects audio quality *far better* than he's ever heard before. Thus, stereo calls for improved record compounds.

Goodyear's answer: PLIOVIC S50, a low molecular weight straight PVC resin with the inherent toughness of PVC resins but with flow characteristics comparable to the copolymers. The result: a superior record at lower raw material cost.

To be specific, vinyl record compounds modified with PLIOVIC S50 have proved their ability to: (1) toughen record grooves, (2) reduce flash, (3) provide better mold reproduction, (4) upgrade processing efficiency, (5) increase abrasion resistance. Most important of all—PLIOVIC S50 *improves audio quality of stereo.*

What about the cost? PLIOVIC S50 reduces raw material costs from ½ to 2 cents per pound of record compound. For all the facts on this outstanding vinyl resin—including latest *Tech Book Bulletins*—write Goodyear, Chemical Division, Dept. J-9441, Akron 16, Ohio.

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Letters to the Editors

Oops, Sorry!

Dear Sir:

In the article, "Brushable Resurfacer for Fiberglass Panels," published in your April issue, a paragraph on page 40 has the following: "The Fadeometer consists of three RS Sunlamps . . ."

We wish to bring to your attention that the word "Fade-Ometer" is a trade name for accelerated fading machines made by our company, and that we have never made a unit containing RS Sunlamps.

J. W. Lane, Pres.
Atlas Electric Devices Co.
Chicago 13, Ill.

(We are indeed sorry for the error which should have been caught by the editors and the review board.—Editor)

• • •

Stress-Cracking of L-P Polyethylene Pipe

Dear Sir:

Mr. Gloor of Hercules Powder Company has called our attention to the article, "Engineering Thermoplastics for Ocean Telephone Cables," by J. B. Howard in your May issue. This article states that according to German sources, pipes of low pressure polyethylene stress crack. (On page 61, "German sources report service failures of cold-water pipe.")

We would like to note that since 1955, we have sold several thousand tons of Ziegler polyethylene to manufacturers of polyethylene pipe. There has not been a single complaint concerning failures caused by stress cracking.

We have carried out extensive laboratory tests on the stress cracking of low-pressure polyethylene pipe. On the basis of these investigations, we introduced at the end of 1956 a greatly improved pipe type. The life of pipe manufactured from this type is expected to be over 50 years.

J. Von Klenck, Ch. of
Appls. Development,
Farbwerke Hoechst AG.
Frankfurt/Main, W. Germany

• • •

Setting the Record Straight

Dear Sir:

On page 80, Column #1, of your September issue, you list Acme Machinery & Mfg. Co. as the manufacturer for Boston Plastic Machinery, Inc., and you list their address as the manufacturer's address, which is very misleading to say the least.

Acme is one of our sales representatives—we have others in various parts of the country—and they most certainly should not have been listed as manufacturers of our machines.

This error could become very costly to us, and we certainly don't want to confuse the general public as to who manufactures this machine.

L. J. Kovach, Pres.
Boston Plastic Machinery, Inc.
Boston, Mass.

(The machine in question was listed as Acme Model B blow molding unit, with a footnote on the same page that "Acme Machinery & Manufacturing Co. for Boston Plastic Machinery Inc. . . ."—Editor)

• • •

Correction Suggested

Dear Sir:

Referring to our telephone conversation, regarding the listing of the Johann Fischer blow molding equipment in your September issue (p. 80) under the name "Barclay," you explained that it was your policy to list all machines under the name of their U. S. sales agents.

We would like to make it clear that the name Johann Fischer enjoys an extremely fine reputation and is the name which is marked on all the equipment.

In the future, we would appreciate your listing and referring to this equipment as Johann Fischer.

H. L. Pokrass
Barclay Industries, Inc.
New York, N. Y.

We invite letters from our readers for publication in these columns.
—The Editor

PREVIEWS

of Next Month

The November issue will feature the following articles:

Dry-Tumbled Blends of High- and Low-Pressure Polyethylene. J. B. Wolheim, Tech. Service Engr., W. R. Grace & Co., Polymer Chemicals Dept., Clifton, N. J.

Results are given for a study investigating the quality of moldings made from blends of polyethylene. Material factors discussed are stiffness, melt index, spiral flow, and specific gravity. Property factors include boilability and impact strength. Important molding factors are shown to be type and size of gating.

•

Properties of Nylon Films. R. L. Hughes, Mgr., and D. G. Simpson, Staff Assoc., Sales Service Lab., Spencer Chemical Co., Kansas City, Mo.

Properties of two grades of the firm's nylon films indicate their suitability for use as packagings. High tensile strength and sufficient elasticity offer the production of tough, impact-resistant films having zero permeability to oils and solvents, and low permeability to other liquids and gases. The films seal on conventional or near-conventional equipment, thus requiring no costly modifications.

•

Techniques for Machining Glass-Plastics Laminates. E. C. Graesser, Chief Engr., Fabricated Parts Engineering & Quality Control, National Vulcanized Fibre Co., Wilmington, Del.

A discussion of practical production methods for successful machining that includes shearing, slitting, sawing, milling, turning, boring, facing, drilling, threading, planing, punching, and reaming.

•

Nondestructive Quality-Control Tests for Finished Reinforced-Plastic Parts. A. D. Coggeshall, Engr., Matls. & Process. Lab., Large Steam Turbine-Generator Dept., General Electric Co., Schenectady, N. Y.

The theory and examples of practical usages are given for a control procedure based on observing the creep or relaxation of parts heated slightly above the glass point when lightly stressed. The resulting stress-temperature combination is shown to be highly specific for each application, and must be determined by actual initial experimentation.

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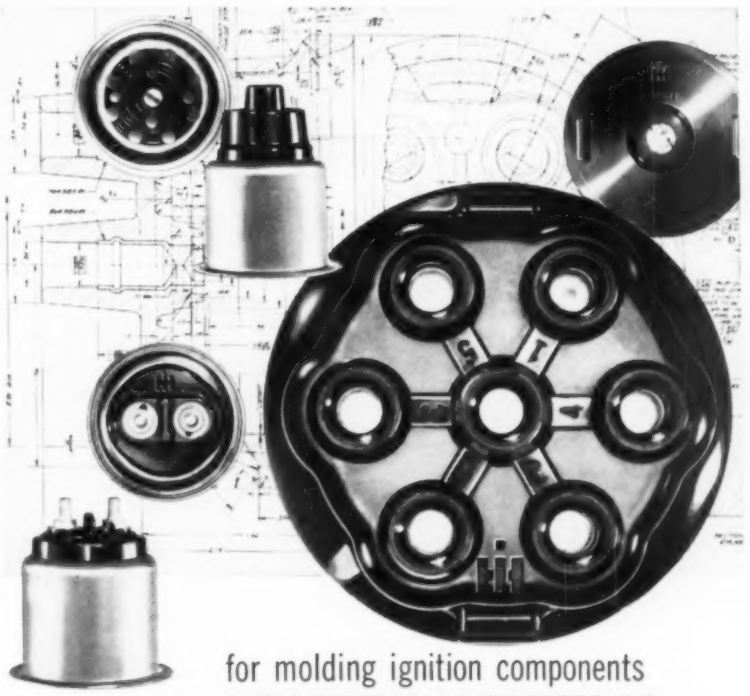
AND DOES—FOR **INTERNATIONAL HARVESTER**



for molding ignition components
INTERNATIONAL HARVESTER CO.
farm tractor division uses

PLENCO

OVER the South African veldt and the Dakota plains, across the Turkish steppes and the stony New Hampshire hillsides, rolls rugged International Harvester farm equipment of truly world-wide reputation and usefulness.

It's a reputation based upon superior performance under all conditions of work and weather. To maintain it, International Harvester designers and engineers take special care with everything that goes into their hard-working products. Special care for the precision molding of ignition components for new I-H tractors included the approval of Plenco phenolic molding compounds. Plenco materials selected offered high dielectric strength and heat resistance properties, vital moisture resistance and dimensional stability.

THE USES of versatile Plenco phenolics are endless. And the number of quality-minded *users* who find the answers to their product or production problems answered with Plenco is a long and distinguished one. Like International Harvester, take advantage of the fact that *if phenolics can do it, Plenco can provide it . . . already made or specially made.*

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FOR BETTER PLASTIC PRODUCTS

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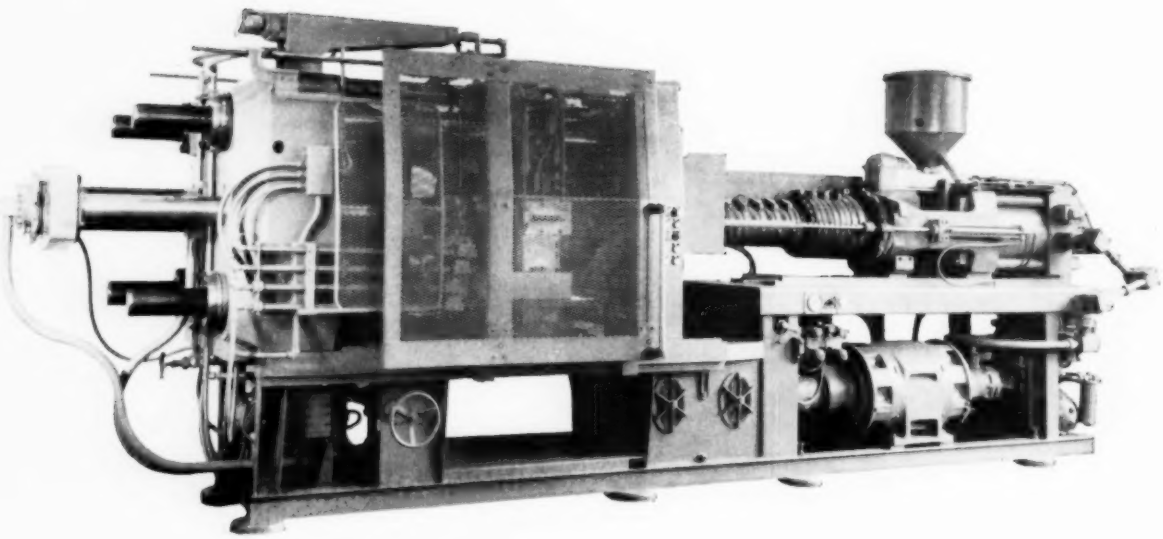
Injection Molding's Most Versatile Performer!



Impco Model HA16–425
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The size of the new HA16-425 "Impco", combined with its speed and adaptability, make it Injection Molding's most versatile performer! Seven hundred and twenty dry cycles per hour at full 24½ inch stroke — two hundred pounds per hour plasticizing capacity — hydraulic knockout — live adjustments, are but a few of the many features contained in this machine. Let us show it to you.

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U.S.I. POLYETHYLENE NEWS

A series for plastics and packaging executives by the makers of PETROTHENE® polyethylene resins

OCTOBER, 1959 — U. S. Industrial Chemicals Co., Division of National Distillers and Chemical Corporation — 99 Park Ave., N. Y. 16, N. Y.

Packaging Notes

Lightweight polyethylene-coated corrugated containers are being used to ship heavy electric typewriters.

Polyethylene was found to be the only material that did not damage the finish of the typewriters. A polyethylene-coated corrugated insert fits over the typewriter inside the container. This liner prevents damage to the typewriter, even if the box is overturned. The box cuts costs 30 percent, and volume 40 percent. Stacking strength is increased 40 percent.

A semi-rigid polyethylene bag inside a corrugated box is being used to package a liquid industrial deodorant. The containers, in quart and gallon sizes, pour easily and are convenient to handle.

This method of packaging reportedly eliminates the problems of freezing and bottle breakage and requires no deposit or return. The new containers require less transportation and storage space than glass or metal ones, providing lower handling costs.

Courtesy Canton Containers Inc.

In an unusually large packaging job, a locomotive was wrapped in a polyethylene film cover for export shipping. The cover was specially made to protect the locomotive from dirt, dust, and water spray during overseas shipment.

A new sealing machine for polyethylene bags reportedly provides substantial savings in packaging costs. The machine features an automatic sealing and cut-off device designed to save up to an inch of film length per bag. It eliminates conventional tabs and is claimed to save up to 15 percent in material costs.

Strong, flexible bags with many properties comparable to metal cans are being produced to package foods. These bags are made of aluminum foil laminated on both sides with polyethylene film, and coated on the outside with cellophane. They are impermeable to gas and moisture. The bags will heat seal, have high impact strength, and will stretch up to 28% (in machine direction) before rupture. They may be used for vacuum packaging, dehydrated food packaging, liquid food packaging. The packages can be boiled.

Growing Market for Polyethylene Film Seen in New Construction Applications

Film Makes Ideal Moisture Barrier for House and Highway Construction

A burgeoning market for heavy polyethylene film is developing out of new uses for the film in the construction industry. Three properties of polyethylene film have been chiefly responsible for its popularity with builders. It is an excellent moisture barrier. It is light-weight, yet strong. It is inexpensive.

Polyethylene sheeting in 4 mil thickness is placed on freshly laid concrete after a film of water is sprayed over entire area. Boards are placed over the joints and edges and left in place for at least 36 hours. Sheeting can be re-used for this purpose, or used as waterproofing under next slab in multi-dwelling construction.

Construction men are using polyethylene film as a moisture barrier under foundation slabs and concrete highway sections, between interior and exterior walls, and as a lining for crawl spaces. On one recent construction job, 70,000 square feet of 4 mil clear film was used under a concrete slab. Installation was facilitated by the light weight of the film — less than 20 pounds per thousand square feet. In house and highway construction, the same film used under concrete as a barrier, is frequently reused after first serving as a cover over other concrete.

On large construction jobs, polyethylene film has proved invaluable as an inexpensive covering for open, unfinished work. The film permits solar heat and light to enter, keeps out wind and dirt.

In house construction, film is being used for window and door flashing and as an under layer for shingle roofs. Film is being laid under shower stalls and in other parts of the house where moisture and water seepage is a problem.

The future of polyethylene in the building industry continues to be brightened by new applications. For example, "bubble houses" held up by air pressure show promise as economical shelters for construction work or for temporary storage. Polyethylene-coated plywood concrete forms that are self releasing have been suggested. New uses such as these promise to continue the spectacular growth which polyethylene has shown over the past few years.

Unsupported Polyethylene "Bubble" Houses Chickens

An air supported plastic shelter, used as a low-cost house for poultry research, has been built at a leading agricultural university.

No inside supports are used for the 10 by 20 foot shelter built with 4 mil polyethylene film. A one eighth HP motor keeps the quonset shaped shelter inflated. It is estimated the building will endure 60 mph winds and support a foot of snow. The success of the shelter suggests its use in meeting temporarily expanded farm storage and poultry shelter needs.

U.S.I. To Co-Sponsor Museum Packaging Show

U.S.I. will co-sponsor an international packaging show at the New York Museum of Modern Art from Sept. 9 to Nov. 9. Several hundred commercial and industrial packages selected from ten countries will be presented. They will range from wrapping materials to a 370 cubic foot container.

The exhibition is intended to re-examine and broaden the concept of packaging in relation to the great variety of products produced today. Outstanding examples of graphic and industrial designs will be shown with emphasis on imaginative use of new and old materials. Experimental and industrial packaging seldom seen by the public will also be exhibited along with well-known commercial applications.

New Slitter Is Faster, Reduces Trim Losses

A compact new machine is reported to shorten slitting time for polyethylene film and to reduce trim losses.

It normally takes 45 minutes to cut a 10,000 ft. roll of film, using a conventional slitter and winder. The new machine is reported to cut the same length of film — on the roll — in five minutes.

When the film is slit on the extruder, three to four inches of selvage material is usually lost. The new machine reduces wasted selvage to as little as $\frac{1}{16}$ of an inch. The new slitter eliminates the problem of fusing at the edge of the roll. The machine is said to cut film in gauges from $\frac{1}{10}$ to 10 mil, in any width up to 72 inches.

U.S.I.

Vol. IV, No. 5

POLYETHYLENE PROCESSING TIPS

IMPROVING EXTRUDER EFFICIENCY WITH PRESSURE GAUGE

Failure to determine the proper schedule for breaker plate and screen pack maintenance can be costly to polyethylene extruders. It can result in losses in production time and deterioration in the quality of the extruded product.

Changing a screen pack when it is not contaminated is an unnecessary waste of valuable production time. On the other hand, allowing the screen to become excessively contaminated poses serious production problems. The increased pressures that develop and the longer exposure of the polymer to heat can cause degradation and oxidation of the polyethylene. These undesirable changes in the resin's physical properties show up in off-quality end products. Excessive pressure, too, may damage the extrusion equipment.

Pressure Gauge Guides Operator

These difficulties can be reduced by installing a pressure gauge in the extruder cylinder wall between the screw and the breaker plate, as shown in the drawing, Fig. 1. The gauge continuously monitors breaker plate condition and indicates to the operator when it is time for screen pack changes.

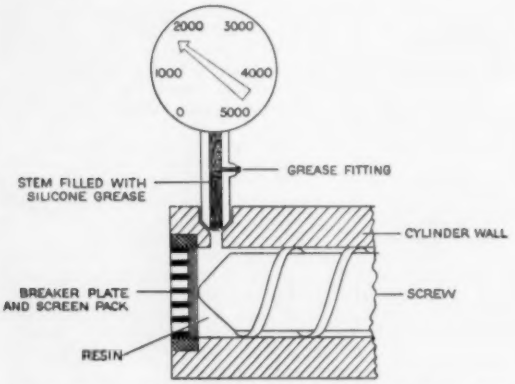

Fig. 1. Diagram of installation of pressure gauge on an extruder

As the accompanying chart, Fig. 2, shows, pressure in the cylinder increases as the area of openings in the screen pack decreases, that is, as screen plugging increases. Pressure, of course, is dependent on operating temperature, screw temperature, and screw speed as well. In practice, the operator first determines operating conditions and screen pack arrangements that produce the best results with a given product, using the pressure gauge as an aid in such preliminary runs.

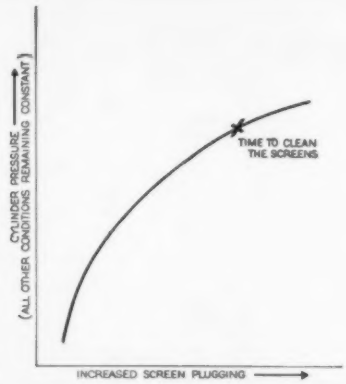

Fig. 2. Cylinder pressure increases with increasing screen plugging

Once operating conditions are established, pressure can be correlated with contamination in the screen pack and breaker plate by experience. The build-up of pressure beyond a given point is the signal that the screen pack needs changing.

How Gauge Operates

The bleeder-type bourdon tube gauge is the pressure-measuring device most commonly used in the extrusion industry. The gauge can be installed on the top or bottom or at any angle on the cylinder. The tube running from the gauge to the cylinder is filled with silicone grease introduced through a grease fitting.

Gauge Maintenance

The tube, or stem, must be kept filled with silicone grease, or else polyethylene resin will be forced into it from the cylinder. If this happens, the resin will solidify, causing inaccurate pressure readings on the gauge. Applying grease through the fitting once every 24 hours of extruder operation should be sufficient. It is best to add the grease between production runs so that the small amount forced into the resin can be easily purged.

If the stem becomes plugged with resin, it can be cleaned quickly. The operator simply removes the stem, heats it, and purges it of resin by forcing silicone grease through it.

Technical Assistance from U.S.I.

Most troubles associated with screen pack and breaker plate maintenance should disappear with the installation of a pressure gauge. But if you have special problems, ask U.S.I. for technical assistance. Our technical service engineers will be glad to work with you in solving them.

U.S.I. INDUSTRIAL CHEMICALS CO.
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Hubley Tic Toy Clock—many of the 40 parts are made on The Lampeter Manufacturing Company's Van Dorns.

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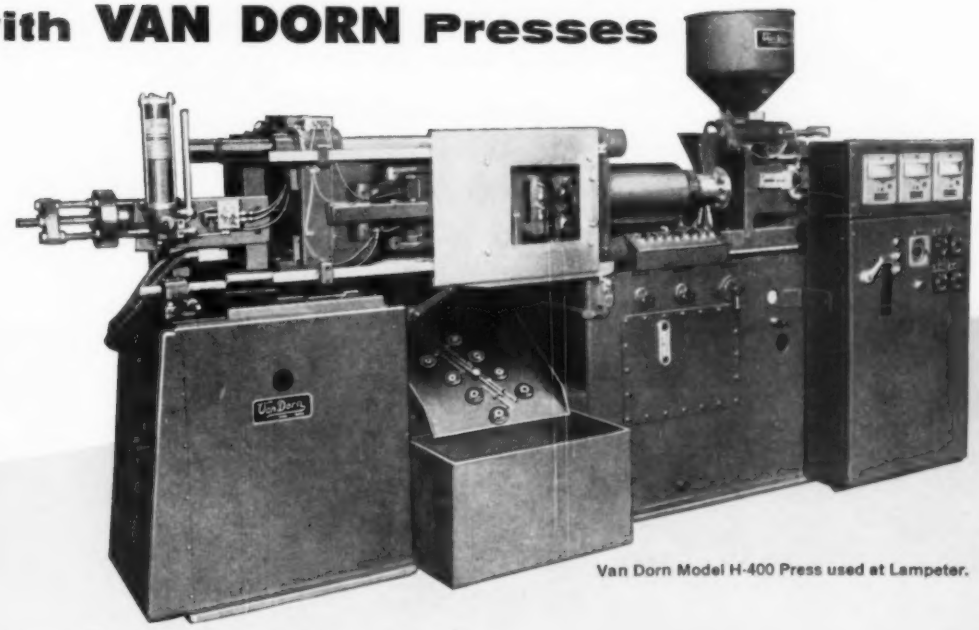
with VAN DORN Presses



Van Dorn Model H-400 Press used at Lampeter.

As a major supplier for The Hubley Manufacturing Company, a leading toy producer, The Lampeter Manufacturing Company is an extensive user of plastic machinery. Lampeter operates their fully automatic Van Dorn 4-6 oz. and Van Dorn 3 oz. presses *24 hours a day, six days per week.*

Besides a substantial reduction of cycle time, the company reports the Van Dorn presses are economical, versatile, and require minimum maintenance. The general manager says that if he buys more machines of the same size, Van Dorns would certainly be a top consideration.

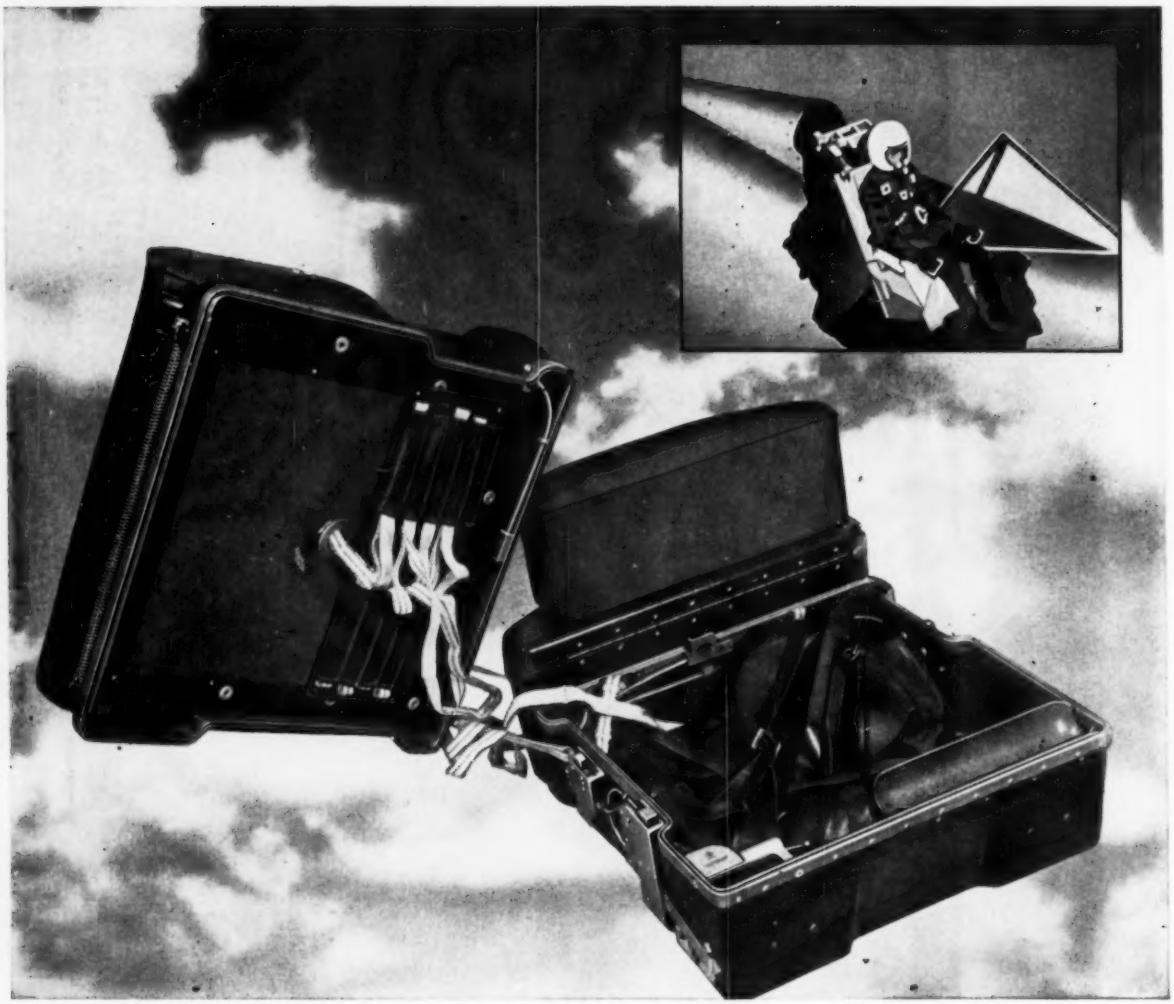
You, too, can save time and money with Van Dorn high production injection presses. Write for detailed information.

Inspection of toy parts produced on the Van Dorn H-300.

Van Dorn

THE VAN DORN IRON WORKS CO.
2685 East 79th Street • Cleveland 4, Ohio

DOW | RESINS



AIRMAN'S "ALLEZ-OOP" SEAT

and survival kit rely on reinforced moldings!

How the Air Force Global Survival Kit can store an airman's basic survival needs*—all in approximately one cubic foot of space within an aircraft ejection seat—is a lesson in ingenuity.

And even more interesting: how the survival kit can withstand the sudden shock of a rocket-fired ejection at fighter-plane speeds, and the impact of a parachute landing in rough terrain is a lesson in the advantages of reinforced polyester molding by the Plastics Division of General American Transportation Corporation.

Various materials were tried, but lacked the high impact strength-to-weight ratio and the necessary resistance to dents, corrosion, and fungus growths of the reinforced moldings. Also important is the economy of reinforced plastic molding. Complex configurations, holes, rounded edges, even color, can be molded in the part, reducing the number of costly operations.

Result: Economy, good appearance, durability, and that extra margin of safety where a life is at stake!

Perhaps your product can benefit from the advantages of reinforced plastic molding. As a supplier of Dow Styrene and Dow Vinyltoluene—basic monomers for the polyester resins used in premix, preform, or mat molding—The Dow Chemical Company invites your inquiries.

*An automatically inflating life raft, two-way radio, knock-down rifle, ammunition, sea-anchor, fishing lines and lures, rations, water-purification tablets, a water dye marker, and an emergency oxygen system.

THE DOW CHEMICAL COMPANY • MIDLAND, MICHIGAN

What's New in Processing

Interested in European methods and techniques of processing plastic materials? **Foster D. Snell, Inc.** and **Robert S. First, Inc.,** two well-known industrial and chemical consulting firms, plan to visit 400 of the major processors of plastics and manufacturers of plastic fabrication machinery in England, France, Switzerland, Sweden, West Germany, Holland, Belgium, and Italy.

Objectives of the study are to determine what processes and machinery are available for license in the United States, give a brief description of each process or machine, provide data on the economics involved, and list whom to see to start negotiations. The survey will begin this December and will be delivered to subscribing clients in September, 1960.

■

Wyandotte Chemicals Corp. has developed a new method for spraying rigid, polyether-based urethane foams. Tackfree in less than five minutes, the foams are said to have twice the insulating efficiency of fiberglass, cork, or expanded polystyrene. The formulation incorporates two Wyandotte products, Quadrol and Pluracol TP 440, a fluorinated hydrocarbon, and a special **DeVilbiss** gun.

The gun meters the components, and output can be controlled at about 3-5 pounds/-minute giving 10-20 boardfeet coverage. Density range is about 2.5-3.5 pounds per cubic foot. Expansion is instantaneous, and very thick (over 7 inches) sections can be applied to vertical surfaces without sag or drip.

■

A recent process patent was granted to Charles Scott and Dallas Grenley, assignable to Dow, covering a method for coating perishable foodstuffs—**2,872,325.** The washed foodstuff is coated with a film-forming latex prepared by the emulsion polymerization of 88-91% vinylidene chloride and 9-12% acrylonitrile.

■

Processing abstracts in recent months include the following: **"The Redux Bonding System,"** R. Berridge, Plastics (London), Nov., 1958, which involves using a phenolic resin with a polyvinyl formal powder to bond aircraft parts.

"Extrusion of Dry, Plasticized PVC Powders," F. Freiman, Ind. Plastiques Mod., Jan., 1959, which describes equipment as well as the process.

"Modern Trends in Molding," A. Kennaway, Rubber & Plastics Age, Nov., 1958, links the newest advance in plastics with methods of engineering mass production, especially in injection molding and thermoforming.

"Laminates of PVC to Steel and Hardboard," W. Martin, Plastics (London), Dec., 1958, describes bonding, application of coatings, aging, and finishing.

"Makrolon Polycarbonate—Its Processing and Applications," W. Hechelhammer and G. Pielstocker, Kunstoffe, Feb., 1959, describes injection and compression molding of the material, extrusion, and finishing.

"Problems with Premix Molding—Part 3," R. White and R. Jackson, Modern Plastics, July, 1959, covers warping, inserts, and thin-wall moldings.

"Principles of Rotary Molding," J. Reib, SPE Journal, July, 1959, is a 15th ANTEC paper.

"Injection Molding FEP-Fluorocarbon Resin," H. A. Larsen, G. R. DeHoff, and N. W. Todd, Modern Plastics, Aug., 1959, is an adapted 15th ANTEC paper.

"How to Make Roll-Chilled Polyolefin Films Commercially," F. J. Meyer, Modern Plastics, Aug., 1959, describes a leading producer's experiences.

A NEW TECHNIQUE

for evaluating carbon black dispersions has been developed by Columbian Carbon's new research center in Princeton, N. J. Using a unique method of photomicrography . . . dispersions may now be accurately judged by visual inspection. (The round area below is a photomicrograph of Columbian's Copeenblak® —a nearly flawless dispersion.)

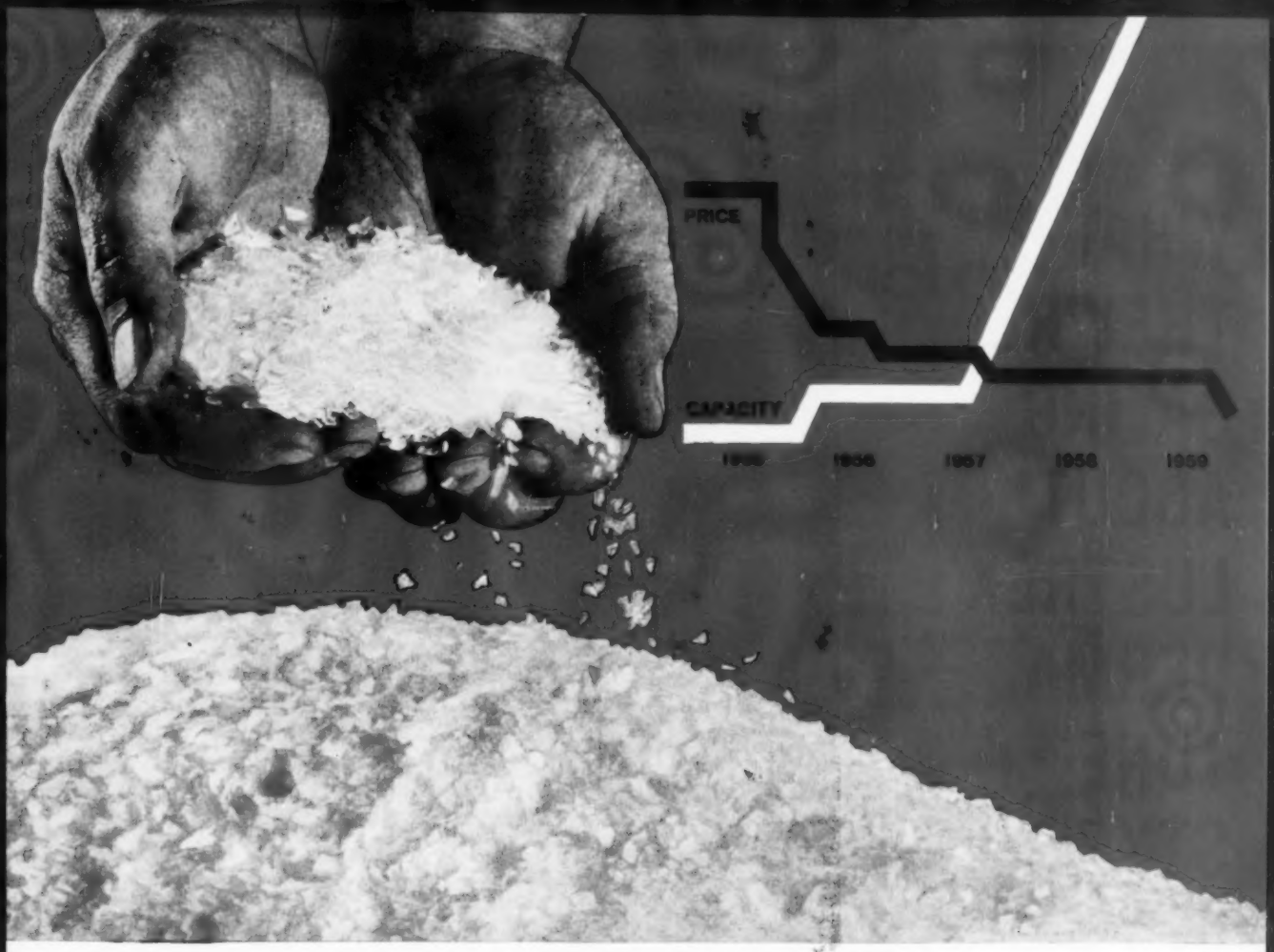
POLYETHYLENE-CARBON BLACK DISPERSION PROBLEMS SOLVED!

FOR POLYETHYLENE . . .

Columbian produces COPEENBLAKS — outstanding dispersions of high quality carbon black . . . made with a masterbatching technique that assures the ultimate in dispersion . . . uniform, batch after batch. Copeenblak means excellent performance at moderate cost. The perfect answer to polyethylene problems is Columbian's Copeenblak. Write for the full story . . . now!

COLUMBIAN CARBON COMPANY

380 Madison Avenue, New York 17, N. Y.



CELANESE TRIMETHYLOLPROPANE . . .

help yourself . . . there's 15,000,000 lbs.

and the price is down 4¢ a pound

First to go on stream with a commercial process for making trimethylolpropane, Celanese transformed this chemical from a laboratory promise to a practical material for the paint industry. Now, with this latest price reduction, you can make coatings even more economically . . . with better quality, thanks to the properties of trimethylolpropane.

In alkyd paints, for example, trimethylolpropane permits improvements in hardness, dry time and curing rate as compared with glycerol-based alkyds. Gloss and color retention are improved. Paint formulations made with trimethylolpropane have better stability against heat . . . greater resistance to overbake. They can take outdoor exposure and weather. They adhere strongly and withstand alkalis and detergents.

Today, a major Celanese production facility at Bishop, Texas, is geared to turn out more than 15 million pounds per year of high quality trimethylolpropane. Celanese also provides technical advisory services to manufacturers. For an interesting bulletin which describes the properties of this versatile chemical and offers data on the formulation and preparation of alkyd and urethane coating resins, write to:
Celanese Chemical Company, a division of Celanese Corporation of America, Dept. 564-J, 180 Madison Avenue, N. Y. 16.

Celanese®

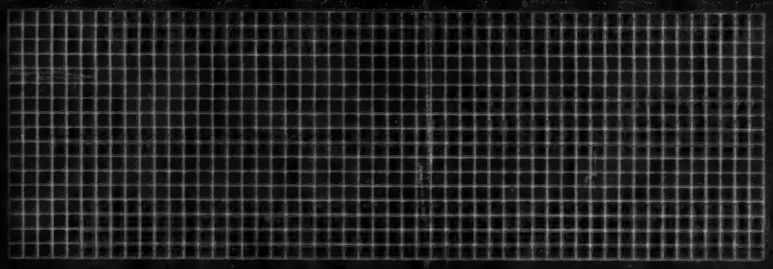
Canadian Affiliate: Canadian Chemical Company Limited, Montreal, Toronto, Vancouver

Export Sales: Amcel Co., Inc., and Pan Amcel Co., Inc., 180 Madison Avenue, New York 16, N.Y.

Celanese
CHEMICALS

WHAT THEY'RE SAYING ABOUT LUSTREX* PERMA TONE STYRENE

Lighting Fixture Molders: "Easy flow, fast cycles . . ." "No molding job too difficult." "Constant color during molding . . ."



Lighting Fixture Manufacturers: "2 to 3 times more resistant to yellowing . . ." "Exceeds IES–NEMA–SPI specs for light stabilized styrene." "Excellent crystal clarity . . . unlimited color possibilities."

To all the inherent advantages of styrene in lighting—the large areas of illumination, the light weight, good diffusion, unusual design effects—perma tone adds excellent light stability, a resistance to yellowing up to three times better than regular styrenes. Proven in use by leading fixture manufacturers, without formulation changes since 1956, perma tone opens up wide new dimensions in color, including truly translucent whites and other difficult colors.

Lustrex perma tone styrene is available for injection molding or extrusion. Write for complete technical data to Monsanto Chemical Company, Plastics Division, Room 1080, Springfield 2, Massachusetts.

Monsanto

*LUSTREX: REG. U. S. PAT. OFF.

OCTOBER, 1959

PLASTICS
THE MAGAZINE OF APPLIED ENGINEERING
TECHNOLOGY

EDITORIAL:

Secrecy—Proper and Misapplied

The Guest Editorial on "Unfair Competition," by Ren Morse of IMS, that appeared in last month's issue probably came as a surprise to those readers who remember our two past editorials, March 1956 and February 1958. These editorials inveighed against secrecy in the plastics industry being carried to ridiculous extremes. This type of secrecy was termed adolescent in type, and prevalent in all relatively new industries.

Now, Ren Morse's Guest Editorial urged secrecy and the closed shop as the only infallible method by which a molder could protect his new developments against pirating copiers. Irreconcilable views, it would appear, and show only that we do not impose any censorship on statements expressed in our Guest Editorials. Another possibility is that PT is changing its editorial views, but this is not so!

•

Thoughtful consideration of both viewpoints will show that they are not completely opposed, but can compliment each other. In other words, proper or legitimate secrecy at first to protect the developer from unscrupulous copiers until the developer takes suitable advantage of the lead-time obtained from his efforts. But this secrecy should not be retained indefinitely—this is only misapplied secrecy that fools no one.

All publications try to be first with the story on any new material, machine, technique, or application. In this magazine, we are interested primarily in new or improved methods and techniques for plastics processing.

As can be imagined, misapplied secrecy is highly irritating and aggravating to us. We can see the same thing being done by two or more companies, yet each firm considers the development a secret that is not for publication. And try to make them understand how ridiculous their secrecy is when someone else is doing the same thing and also considering it a secret, not for publication!

This problem of misapplied secrecy can also be aggravating to public relations people, as witness Lucien Greif's Guest Editorial in this issue. The situation could be termed humorous were it not so tragic! How can plastics be termed an adult industry when it is too rife with childish "secrets"?

•

Our previous editorials on secrecy named the misapplied-secrecy stage that of an industry's adolescence—difficult, often painful, and lengthy in duration. Observers of any other industry that has outgrown this stage will agree heartily—ask the steel industry about their secrecy stage when erstwhile competitors would examine each other's files after two companies consolidated, and found that each had guarded the same secrets.

Lucien Greif's Guest Editorial mentions the benefits to be derived from logical publication of new developments. Don't you agree? Survey your company's secrets and determine which are misapplied and can be released. If conforming to the requirements, make them entries in our Achievement Awards program, and benefit from the publicity and good will you and your firm will obtain.

Arthur M. Merrill
Editor

You'll get a better product tomorrow

Every phenolic compound we formulate is proved in our Development Laboratories. It is molded on our most advanced equipment to determine how you can achieve optimum performance. Typical tests conducted are those for physical properties, chemical and electrical characteristics, molding and curing behavior.

But this is only part of the testing carried out in the laboratory and in the field. It pays off, as proved by BAKELITE Brand *BMM 7001* and *BMM 7002*—two new general purpose phenolics you'll want to know more about.

BMM 7001 was developed for use in cold powder automatic molding where mold and flash release are important. It is practically free of dust and fines. *BMM 7002* is ideal for plunger molding when you want fast plunger travel and cure. Both materials are available in black and brown.

Bringing you the newest and best in molding materials is our business. That's why our 49 years of experience are backed by the most modern and complete technical facilities available. Find out how valuable this policy can be to you. Talk to your Union Carbide Plastics Company representative. Or write Dept. JQ-03G, Union Carbide Plastics Company, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, N. Y. *In Canada:* Union Carbide Canada Limited, Toronto 7.

UNION CARBIDE

BAKELITE and UNION CARBIDE are registered trade-marks of UCC.

▶ This 150-ton, self-contained, automatic press is equipped for *both* compression and plunger molding . . . typical of the laboratory equipment used in the evaluation of phenolic materials.

◀ This intricate, two-piece molding demonstrates the excellent performance of new BMM 7002 in production. Thin louvres, thick sections, intricate details . . . requirements the material could meet as proved by Development Lab tests *before production*. ("Magnajector" projects drawings, pictures and printing. Manufactured by Rainbow-Crafts, Inc., and molded by Recto Molded Products, Cincinnati, Ohio.)

STOKES
150 TON AUTOMATIC PRESS
CLAMPING FORCE - 150 TONS
INJECTION FORCE - 25 TONS
MOLD TEMPERATURE - 350°F
OVERALL CYCLE - 85 SEC.
CURE - 60 SEC.

with PHENOLICS we mold here today

SHORT OR TALL
. . . we make them all!

World's largest stock of injection machine nozzles

SHIPPED RIGHT NOW . . . PHONE YOUR ORDER!

. . . . . and we mean it, a call has your nozzle on its way in five minutes! If it's a "special" just phone in the details, it will be in the shop tonight . . . machined . . . heat treated and shipped to you, usually in 3-4 days.

Be sure with IMS QUALITY NOZZLES. Code-dated for your protection, with Rockwell C Hardness etched on every hex.

CUT YOUR PRESS DOWNTIME

We do not sell cut rate nozzles because press downtime costs you more than the few extra cents needed to get an IMS QUALITY TOOL STEEL REPLACEMENT NOZZLE!

IMS Independently Designed Nozzles are better, last longer and cut your injection molding costs. We specialize in Uniform Design Extension Heated Nozzles to save you money.

Send for our Stock Heater Band List today!

WHATEVER YOUR REQUIREMENTS

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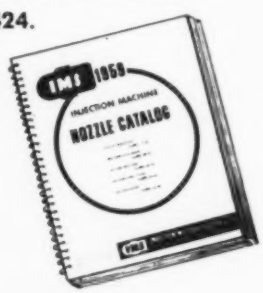
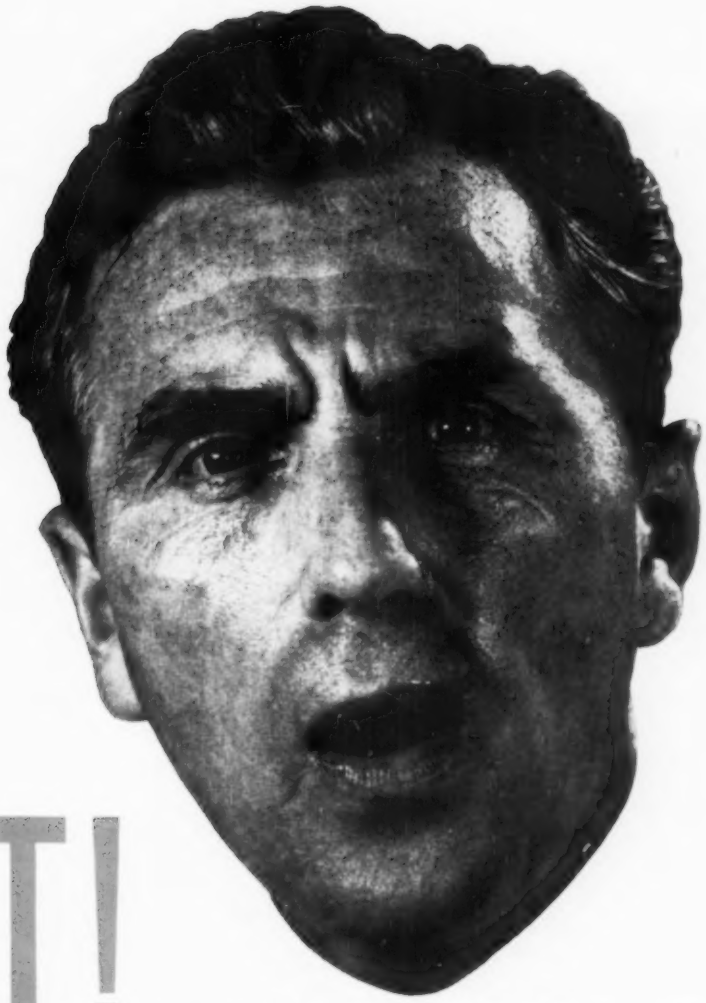
Phone Cleveland, Ohio, WYoming 1-1424.

SEND FOR YOUR
FREE
NOZZLE CATALOG
TODAY!



Injection Molders Supply Co.

3514 Lee Road WYoming 1-1424 Cleveland 20, Ohio



WHAT! *another PVC resin?*

YES, SIR!

. . . and what a resin this is! It's ESCAMBIA* 3000 Series—a totally new and improved type of PVC polymer that offers you even better processing and improved products, because of these three particular characteristics:

- Ability to absorb plasticisers at room temperature
- Shorter dry blend cycles
- Unusual freedom from gels

These important properties have been achieved without sacrificing the usual excellent color, clarity and heat stability associated with other ESCAMBIA resins.

If you're not *completely* satisfied with your present resin, give ESCAMBIA 3000 a chance to prove what it can do for you. Write today for samples and specifications. If desired, ESCAMBIA Technical Service Engineers are available to assist in your plant trials.

ESCAMBIA
CHEMICAL CORPORATION
261 Madison Avenue • New York 16, N. Y.
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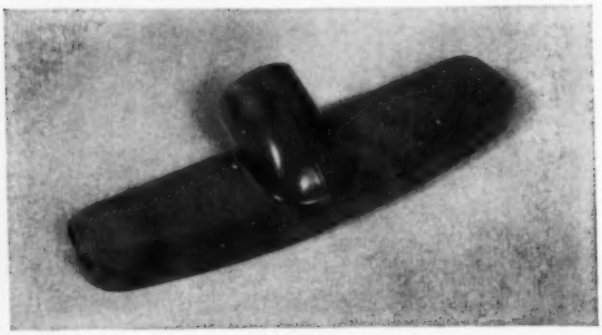
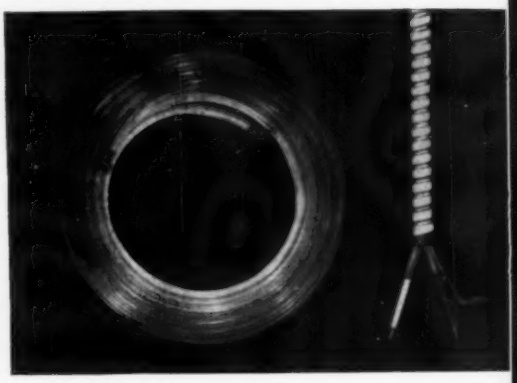


OPALON*

for every possible type of vinyl application



A wide range of **OPALON VINYL** resins and compounds have been perfected by Monsanto to meet the specific needs of molders of appliance parts, housings, toys, phonograph records, rain-wear . . . extruders of wire and cable insulation, garden hose . . . calenderers and extruders of vinyl film and sheeting . . . manufacturers of floor tile . . . coaters of textile and paper for upholstery and wall coverings . . . and compounders of plastisols for metal coating, slush-molding, foaming, and dipping. Specify **OPALON** vinyl—and profit from Monsanto research, experience, and productive capacity. Monsanto Chemical Company, Plastics Division, Springfield 2, Massachusetts.

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This Month In Brief

"Secret!" is the editorial theme for this issue. Our Editorial deals with "Secrecy - Proper and Misapplied," and differentiates between the two types. Proper secrecy is often the only method by which a developer can obtain true protection for his development, and thus the necessary lead time in exploitation that it merits. On the other hand, misapplied secrecy (which can also be termed childish, mistaken, improper or illogical secrecy) is the major blockade to be hurdled before the plastics industry can attain true maturity or adulthood.

This misapplied secrecy bug and how it affects publicity and public relations work is also the subject of this month's Guest Editorial. Here, the author presents four advantages to companies that proper publication release offers.

Some notes on the Technical Articles appearing in this issue are as follows:

The lead article, "Mold Design for Premix," provides the reader with some basis for design and fabrication of molds for premix materials in order to mold at costs consistent with production rate and volume requirements.

"A Study of Compression Molding Pressures" discusses the role of pressures in all types of molding jobs.

"Thermoforming Biaxally-Oriented Film and Sheeting" covers the important variables in forming, and describes recent developments in forming equipment and product design.

"Effects of Molding Variables on Reinforced-Plastic Products" describes and discusses a test program and results obtained on variables that are readily controllable by the molder.

Two new Engineering Forum columns - Blow Molding and Injection Molding - begin this month, and will appear regularly in the future. The first deals with "The Trained Personnel Problem in Blow Molding," and brings up the manpower problems that the new industry field must face and overcome. The Injection Molding forum column is of an introductory type, and invites readers to furnish topics for discussion in the future that will make the forum effective and interesting.

For each a specific . . . Only National Lead to produce desired quality in

These National Lead Stabilizers meet the needs of every volume vinyl product.

FOR OPAQUES

A[1,2],	**TRIBASE* TRIBASE-E*** (Tribasic lead sulfates)	For high heat stability in vinyl electrical insulations.
B.	**LECTRO® 60** (Lead chlorosilicate complex)	Economical stabilizer for electrical insulation.
C.	**LECTRO® 77** (Lead Chlorophthalosilicate)	Heat and light stabilizer for primary electrical insulations.
D.	**LECTRO® 78** (Tetrabasic lead fumarate)	Heat and light stabilizer for high temperature compounds.
E.	**DYTHAL®** (Dibasic lead phthalate)	Excellent heat and light stabilizer for film, sheeting, high-temperature electrical insulation.
F.	**DYPHOS®** (Dibasic lead phosphite)	Outstanding anti-oxidant; heat, light and weather stabilizer.
G.	**TEMEX® 3** (Barium-zinc organic)	Outstanding stabilizing plus chelating action in vinyl-asbestos flooring. Sulfide stain resistance . . . no lubricity.

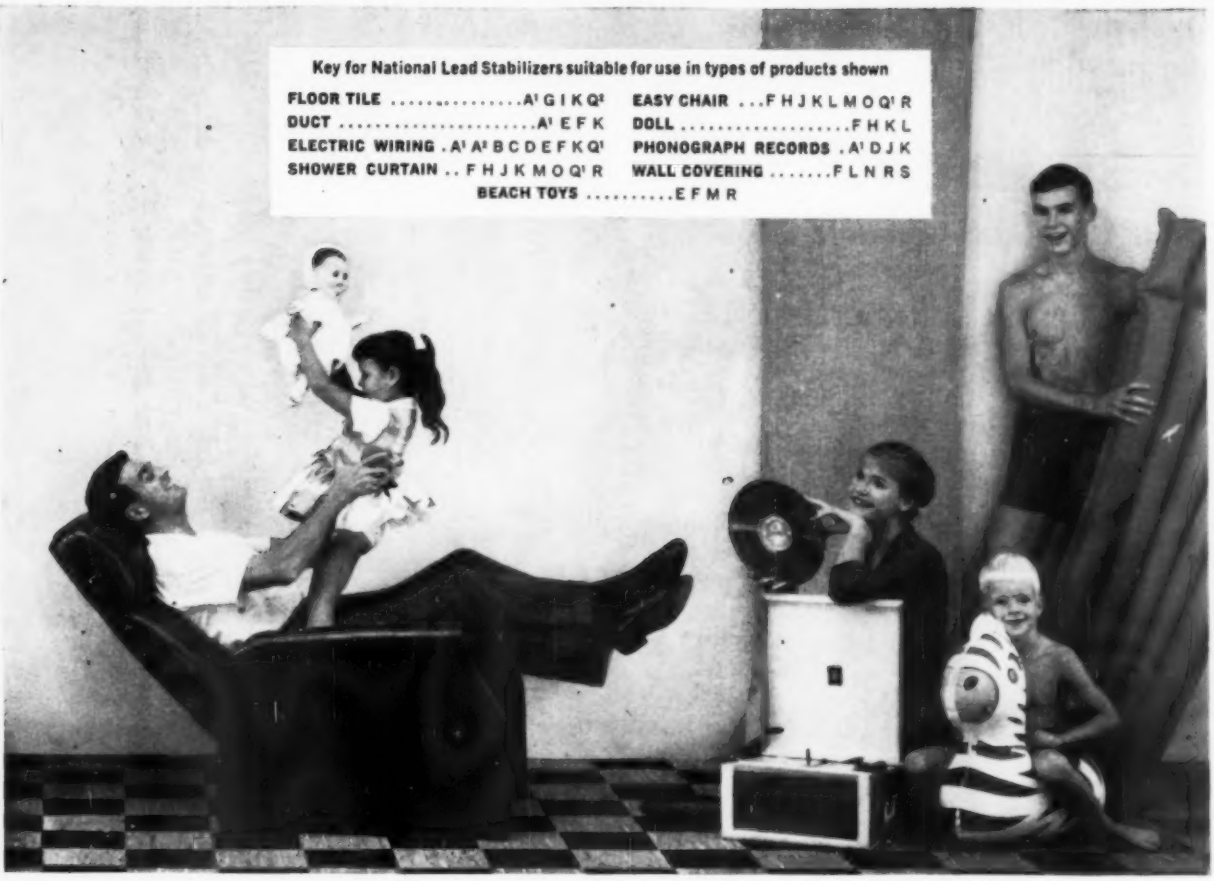
FOR TRANSLUCENTS

H.	**PLUMB-O-SIL® B and C** (Co-precipitates of lead orthosilicate and silica gel)	For translucent and colored film, sheeting, and upholstery stocks.
I.	**NORMASAL®** (Normal lead salicylate)	Stabilizer or co-stabilizer for flooring and other compounds requiring good light stability.
J.	**LEADSTAR*** (Normal lead stearate)	Provides economical lubricating, stabilizing, waterproofing in record discs, extrusions.
K.	**DS-207®** (Dibasic lead stearate)	Stabilizer-lubricant. Excellent for vinyl records. Also co-stabilizer for vinyl insulation.

FOR CLEARS

L.	**INVIN* 85** (Liquid barium-cadmium-zinc organic)	New vinyl stabilizer specifically designed for plastisols and organosols. Minimum effect on viscosity. Rapid air release.
M.	**INVIN* 91** (Liquid barium-cadmium organic)	New! Protects against yellowing, provides lasting crystal clarity, heat, light stability. Compatible in clear, colored, filled stocks.
N.	**FLOMAX® 25** (Barium-cadmium organic)	Liquid stabilizer. Excellent heat stability and clarity.
O.	**INVIN* 205** (Barium-cadmium-zinc organic)	Stain-resisting liquid stabilizer with high heat stability.
P.	**INVIN* 210** (Barium-cadmium-zinc organic)	Liquid heat stabilizer with superior stain resistance.
Q[1,2],	**PROVINITE® CLARITE®** (Barium-cadmium organics)	Two-part stabilizers for clears. Provinite is general purpose. Clarite for extrusions, flooring.
R.	**HALZIN® N** (Liquid zinc organic)	New co-stabilizer for barium-cadmium types. Provides sulfide stain resistance; adds heat stability.
S.	**CS-137*** (Barium-sodium organic)	Outstanding stabilizer for transparent organosols and solution coatings. Remarkable light and weather resistance.

*Trademark


Key for National Lead Stabilizers suitable for use in types of products shown
FLOOR TILE .....A¹ G I K Q²
DUCT .....A¹ E F K
ELECTRIC WIRING . A¹ A² B C D E F K Q¹
SHOWER CURTAIN .. F H J K M O Q¹ R
BEACH TOYS .....E F M R
EASY CHAIR ...F H J K L M O Q¹ R
DOLL .....F H K L
PHONOGRAPH RECORDS . A¹ D J K
WALL COVERING .....F L N R S

makes every stabilizer needed these volume vinyl products

Every one of these vinyl products is sold in volume.

Every one depends on a careful balance between desired quality and low volume cost to achieve market acceptance.

To maintain quality at the desired level, every one must be stabilized against specific heat or light effects which may damage the stock during production or in service.

Only National Lead produces *all* the stabilizers needed to overcome *all* the heat and light hazards encountered by *all* the vinyl stocks used to make the types of products shown above. The table at the left shows these versatile National Lead Company stabilizers and their principal applications.

In the sometimes difficult choice of the proper vinyl stabilizer, there are distinct advantages in dealing with a single knowledgeable supplier in a position to recommend objectively from a complete line of stabilizers.

National Lead, as you can see, is in that position and at your call for technical aid in the application of our stabilizers.

A Chemical Development of **National Lead Company**

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When you slide behind the wheel
of your 1960 model...

Bee coatings are everywhere!

Even though you're "in the business," the imaginative use of color and varying textures on plastic materials contribute greatly to your desire to own a brand new 1960 car.

Logo Division of Bee Chemical Company has *matched* approximately 150 colors for coatings being used for painting vinyls, ABS copolymers and other thermoplastics. Every major automobile manufacturer has accepted Bee color-matched coatings.
They are used for:

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Glove Compartment Doors
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Exterior Identifications and Trim

Some of these parts require coatings in matched colors, for vacuum metallizing, protective and special-effect coatings. Bee produces coatings for all these applications.

Automobiles are big business . . . but so is yours. Bee knowledge and experience—plus our willingness to provide you with the kind of shirtsleeve service that gets results—can be valuable to you. If you've an unsolved coating application, contact Bee—now!

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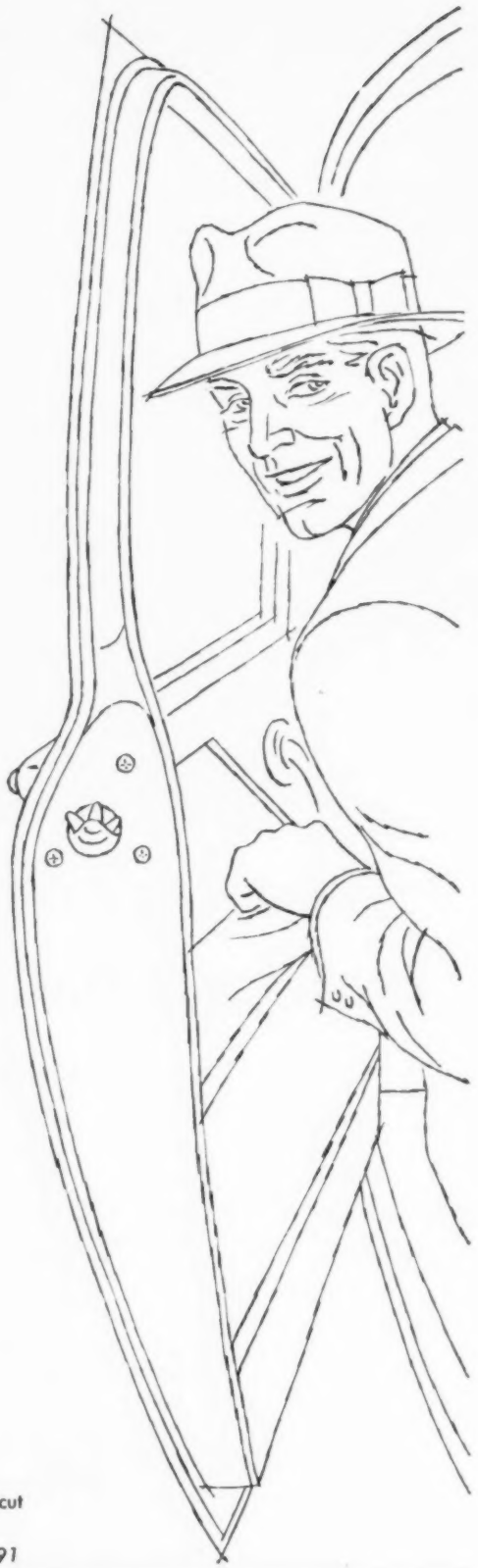

Polyester resins made with **Oronite Isophthalic** *perform better!*

Consider the many advantages isophthalic polyester resins offer you—greater physical strength, greater retention of strength under and after stress, better durability on exposure to time, water and weather. These performance improvements have been demonstrated time and time again in end products such as boats, automotive bodies and cabs, pipe, luggage, business machine housings and many others.

Ask Oronite for isophthalic polyester resin formulations and samples. Possibly Oronite has a formulation that will perform better in the products you market or intend to market.

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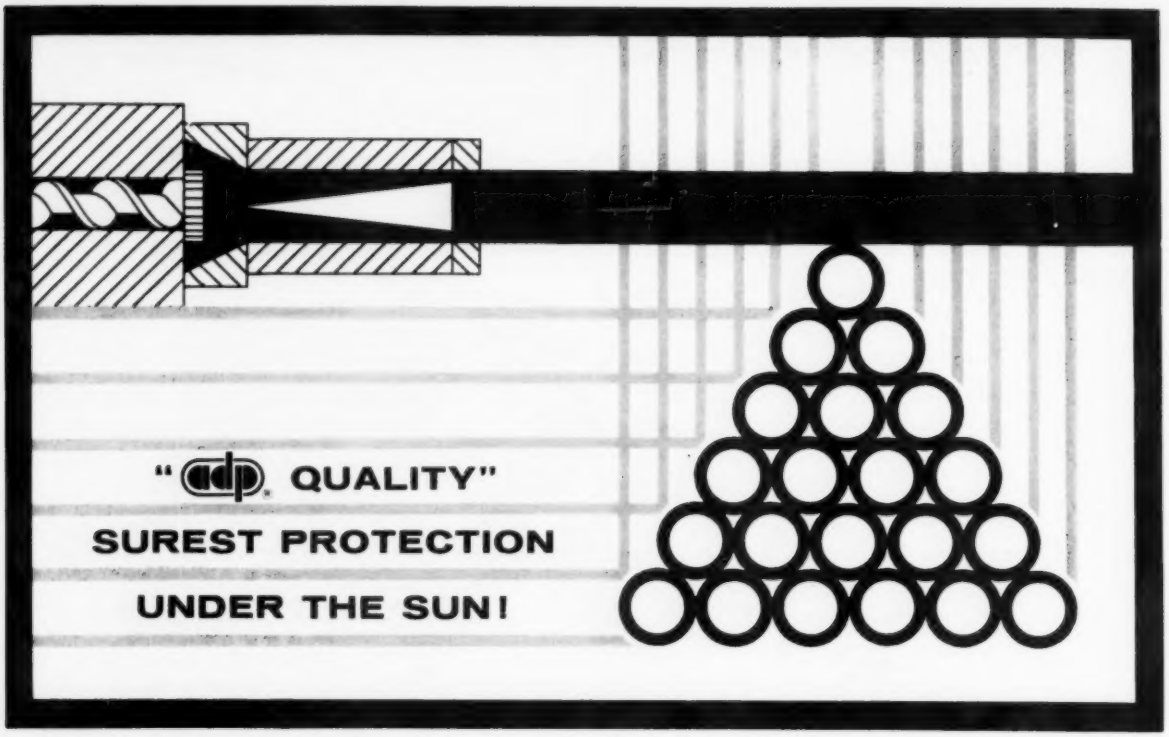

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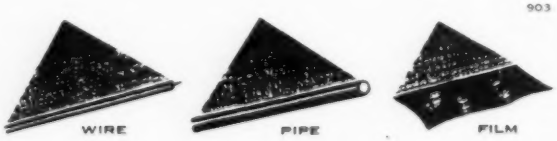

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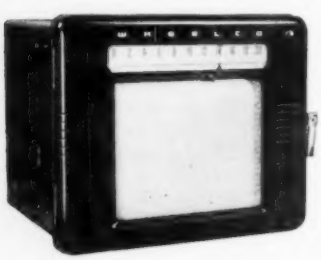

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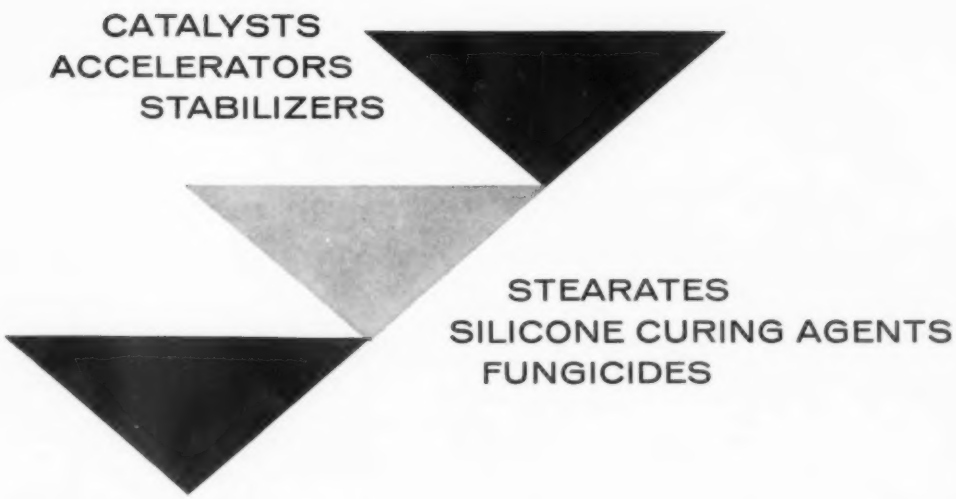

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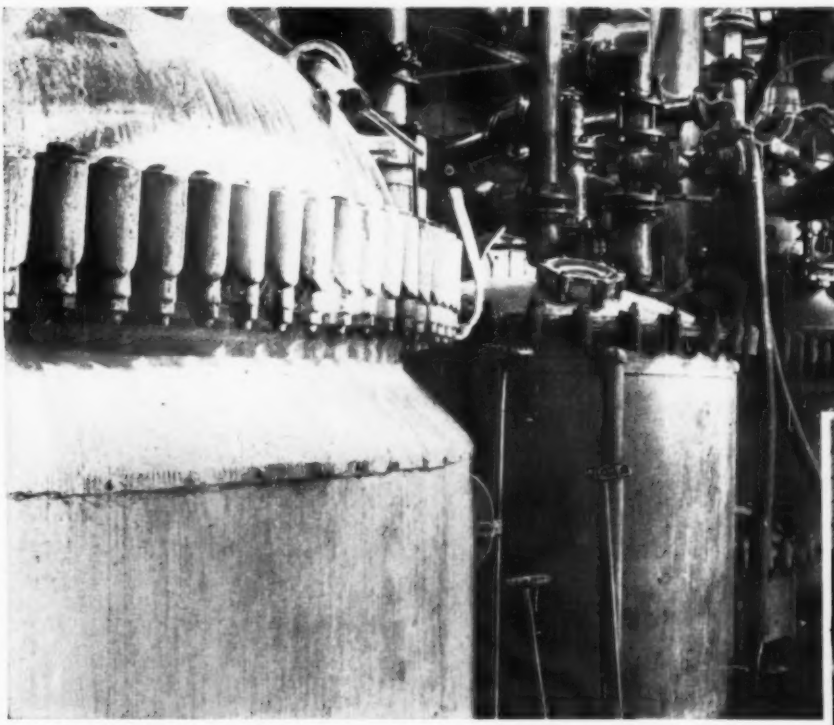

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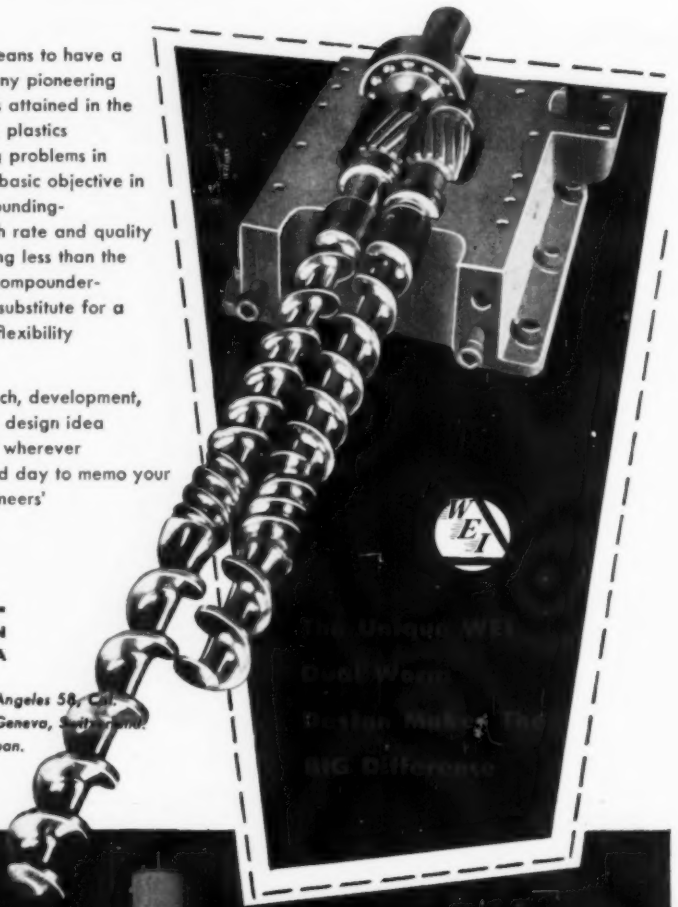

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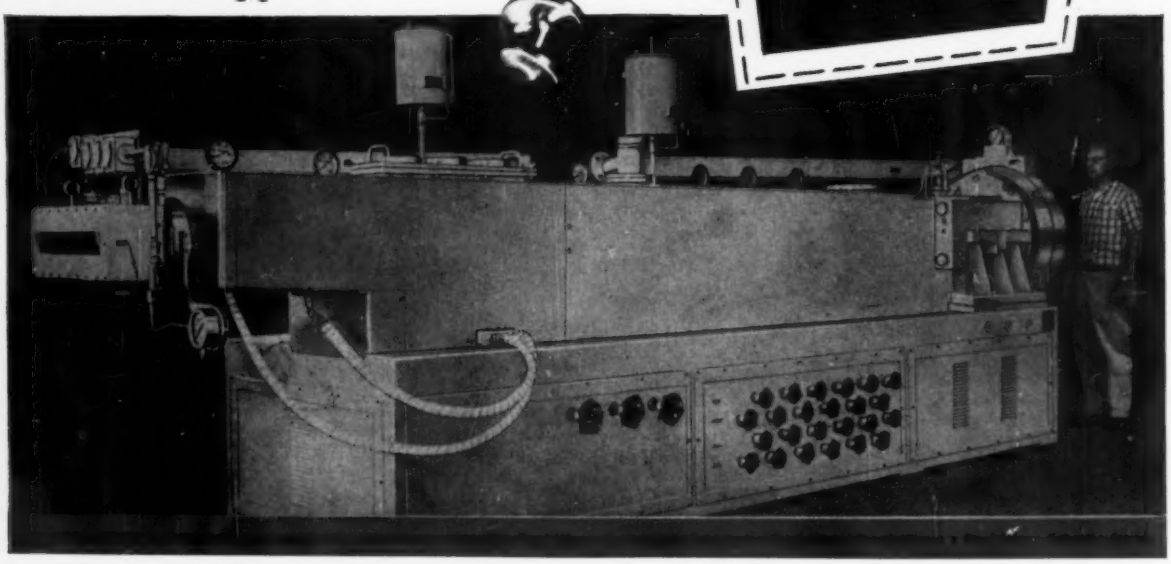

PLASTICS
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Mold Design for Premix

A survey of design trends being used by premix molders for various types of production molds.

H. J. DUPREZ, *Project Engr.*,
Plastics Department,
Wallace & Tiernan, Inc.
Belleville, N. J.

INTEREST in Premix molding has developed slowly, mainly because the mold design for handling these fibrous materials is unpublicized and few molders are willing to invest in the costly design and fabrication of a mold which may or may not work successfully.

As a general answer to the question of "how to design a mold for premix," standard mold design practice for general-purpose phenolic materials may be applied. Nevertheless, this general statement serves only as a stepping stone to the problem of mold design for premix, and should not be taken as the complete answer to this problem.

The purpose of this survey is to familiarize the reader with the design trend employed by molders of premix to obtain a good production mold for the least possible cost. Information on this subject is confined to the experience of very few molders and moldmakers, since a limited number of case histories presently are available, and few mold designers are willing to admit their unsuccessful tries among the successful works.

This paper covers mostly the compression molds, because very little data on transfer molding of premix material currently is available. This, of course, does not eliminate the use of transfer molding for premix, but the writer is too inexperienced in the transfer molding field to attempt coverage of mold design for this particular application.

Mold Materials

Various metals have been used for the fabrication of molds for premix. The reason for selecting any one of these materials depends on many factors such as cost, number of parts to be molded, tonnage of the molding press, fibrous filler concentration of the premix, finish requirements of the parts, etc.

Hardened steel molds are used to produce a majority of the premix parts molded today. This selection does not eliminate the use of other materials (such as non-heated treated steels and non-ferrous metal) for molding of prototype, pre-production, or limited-production parts.

The most commonly used materials are discussed as a group because of their common advantages and disadvantages in either prototype or short-run molds, and in production molds.

This section on mold materials deals with generalities due to the large number of specific materials that may be utilized to a common end-result.

Prototype and Short-Run Molds

This category includes such metals as aluminum, kirksite, silicon-bronze, or even low-carbon steel. The main reason for selecting these materials over the better grades of tool steel, pre-hardened steels, or even cast steel is their relatively lower costs which can be attributed mainly to their ease of fabrication. These materials, with the exception of low-carbon steel, can be cast with enough accuracy to reduce the machining cost over that of heat-treatable or pre-hardened steels and, therefore, reduce the fabrication time. The low-carbon steels find their application in the fabrication

Hughes J. Duprez was born in France in 1926. After receiving his elementary and secondary school education, he came to the United States and attended Indiana Technical College, being awarded a B.S. in Chemical Engineering in 1951. From 1951-1955, he was employed by the Plastics Dept. of Fairchild's Guided Missiles Division as Engineer in charge of plastics development & chemicals. From 1955-1957, he was Project Engineer and Consultant on plastics for the Aircraft Engineering Group of East Coast Aeronautics, Inc. He came to Wallace & Tiernan, Inc., in 1957, in his current capacity as Project Engineer and Consultant for the company's Plastics Dept. He is in charge of prototype fabrication, tooling, and production planning of plastics items used in chlorinators and navigation instruments, and also acts as consultant on plastics designs to the firm's engineering department.

He is a member of SPI, and is active in the Society's Preform and Mat Molding Committee. Mr. & Mrs. Duprez have two children (a four-year-old boy, and a two-year-old girl), and make their home in Morris Plains, N. J.

of small molds because of their lower cost and ease of machining.

Aluminum and kirksite are used exclusively in the fabrication of molds for premix materials having high-flow characteristics. The relatively-low compressive strength and lack of surface hardness, even when chemically treated (anodized, hard coated, etc.), shortens the life of the mold through wear of the seal and scratching of the surface.

Silicon-bronze could be considered as intermediate in cost between cast aluminum and cast steel for mold fabrication. It can be machined more easily than steel, being softer, but requires a heavy chrome plating in order to keep the cure of the resin from being inhibited by the copper in the silicon-bronze alloy. In general, the surface is less porous than cast aluminum and, therefore, a higher finish can be obtained. In addition, better wearing characteristics are imparted from the chrome plating. Nevertheless, the cost saving from the silicon-bronze over cast steel molds usually is not large enough to warrant the disadvantage of this material.

In general, these materials (aluminum, kirksite, silicon-bronze, and low-carbon steel) are suitable for prototype and short-run molds, but definitely are not recommended for production tooling because of their particular limitations.

Production Molds

With the exception of a few cases where aluminum was used fairly successfully as a mold material, the general trend in the premix field is to specify some of the better-grade steels for fabrication of production molds.

There are basically three approaches to making a mold; namely, casting, forging, and straight machining of bar stock. Each of these methods chosen from a cost or design standpoint requires the special grade or type of steel that best lends itself to the application. A minimum body hardness of 30 Rockwell "C" and a seal-edge hardness of 45-50 seems to be necessary to obtain long life, as well as the basic physical strength required of the production mold.

Following are the most commonly used steels and some of their particular characteristics:

SEMI-STEELS OR NODULAR IRONS. Semi-steels or nodular irons (such as Meehanite Type A) can be cast easily, have the strength requirements, and have a low initial cost when compared with other steels. They have a cast hardness of approximately 40 Rockwell "C," can be annealed for machining, and the seal edges can be flame-hardened easily up to 50 or 60 Rockwell "C." The grain structure is good, but slightly porous when compared with other steels.

FORGING STEELS. Forging steels (such as SAE 1045) can be forged, cast by such processes as the Shaw Process, annealed for machining, and heat-treated. The edges can be flame-hardened. The surface usually is good enough for the majority of applications. The initial cost is higher than that of semi-steels, but lower than for the pre-hardened or tool steels.

PREHARDENED STEELS. Prehardened steels (such as CSM #2 from Crucible, Cascade from Latrobe, and Luster Die from Bethlehem) are supplied in bar or plate stock having a hardness of 30-35 Rockwell "C." They are designed especially for straight machining in the "as received" condition without additional treatment, and are of a medium price range.

AIR-HARDENED TOOL STEELS. Air-hardened tool steels of the H-13 formulation (such as Nu-Die-V from Crucible, and V-D-C from Latrobe) are becoming the most popular because of their ease of handling. They can be cast, forged, or machined from bar stock. They can be heat-treated and annealed easily, and commonly are used at a hardness of 50-55 Rockwell "C."

OIL-HARDENED TOOL STEELS. Oil-hardened tool steels are losing popularity, even though they make excellent molds, since there is a greater cracking risk during the heat-treating operation than any of the forementioned steels.

Production Mold Finishing

The better the finish of the molding surface, the easier the part will separate from the mold. Finish of the part will reflect the finish of the mold. This statement goes for all metals used in mold fabrication.

Among the different honing and finishing operations, liquid honing, also called hydroblast or vaporblast, sometimes employed to remove scale after heat-treatment, gives a dull surface which has amazingly good

release characteristics.

As a last hand-polishing operation before final buffing, draw polishing is a preferred method. This is done by polishing in the direction of the closing of the mold, and helps greatly in the release of the part from the mold.

If chrome plating is used, a flash plating of 0.001-inch or less (preferably 0.0001-inch thick) should be applied, otherwise peeling might occur.

General Mold Design

The standard mold construction for compression molding, as used in the melamine and phenolic field, generally appears to be adequate for the fabrication of molds for premix molding. The side-wall thickness may be less since the pressures exerted during the molding operation are lower. The mold, nevertheless, should not be designed to the low molding pressures publicized for some of the premix molding compounds, namely 300-500 psi. Compressed material is restricted within the mold cavity by a tight seal, and the available pressure from the press becomes the limiting factor. The mold should be designed accordingly.

The base plates can be fabricated from low-carbon steel. Pillars or spacers for the ejection plates can be fabricated advantageously from an aluminum alloy, both for lesser weight and better heat transfer, when the mold is heated from a platen.

In some instances, when no ejection mechanism is necessary, the base plate may be eliminated and the bolting of mold to press platen can be done through holes traveling the whole thickness of the mold and picking up tapped holes in the press platen.

Heating of Production Molds

The majority of production molds having a cavity depth of six inches or more are heated from steam-heated platens or a combination of steam core and heated platens. When this technique is used, the steam running through the upper part of the mold should be in series with the steam going through the platen in order to maintain more uniform heat.

Another means of heating a deep cavity—where the side walls are robbed of the necessary heat by radiation and general heat loss—is by fastening steam heaters to the outside of the mold and connecting them to the steam supply. These heaters give the additional heat required without having to bore the mold for steam passages.

Some molds are heated electrically, in which case Calrod-type heaters are imbedded into the walls of the mold one inch or more below the molding surface. This type of heating also is used as secondary source of heat for cold areas of molds heated from a steam platen.

Mold Seals

Figures 1-6 picture the most common seal designs used by some premix molders and recommended by the premix suppliers. These seals were developed through extensive study and experience. Each one of these seals has its reason, being dependent on the end-product requirements or cost considerations.

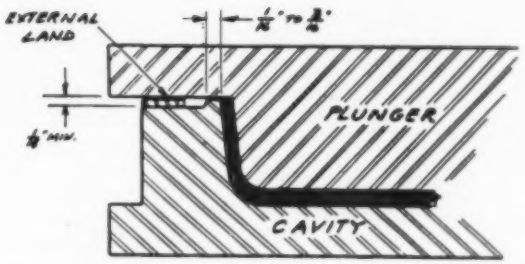

Fig. 1. Cross-sectional drawing of externally-landed flash mold.

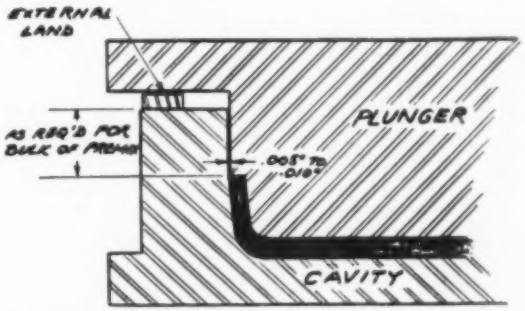

Fig. 2. Cross-sectional drawing of externally-landed positive mold with vertical flash.

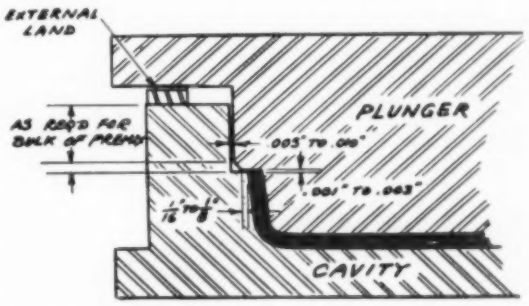

Fig. 3. Cross-sectional drawing of externally-landed positive mold with horizontal flash.

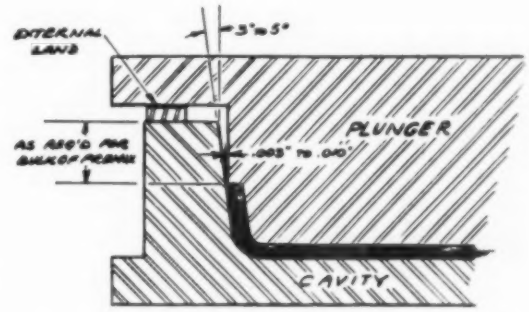

Fig. 4. Cross-sectional drawing of externally-landed semi-positive mold with vertical flash.

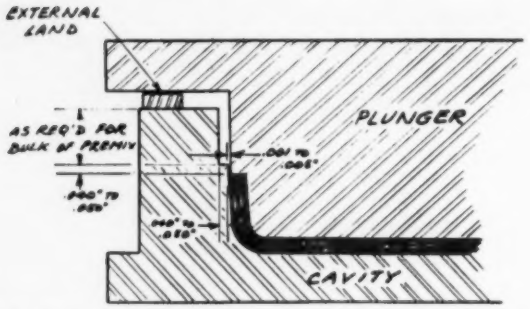

Fig. 5. Cross-sectional drawing of externally-landed semi-positive mold with vertical flash, somewhat less positive than Figure 4.

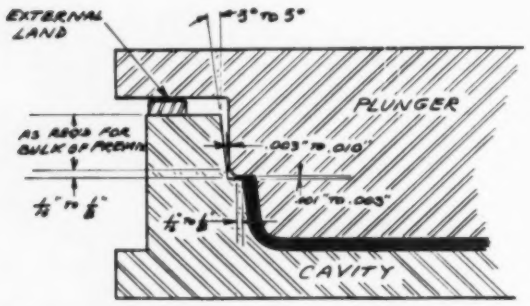

Fig. 6. Cross-sectional drawing of externally-landed semi-positive mold with horizontal flash.

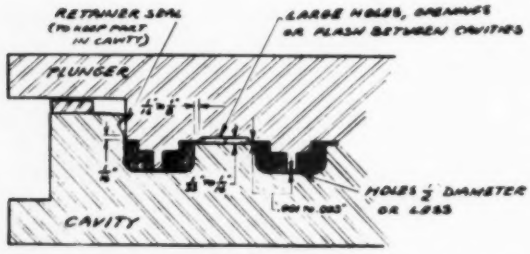
RETAINER SEAL (TO KEEP PART IN CAVITY)
LARGE HOLES, OPENINGS OR FLASH BETWEEN CAVITIES
PLUNGER
HOLES ½" DIAMETER OR LESS
CAVITY

Fig. 7. Cross-sectional drawing of mold showing multi-cavity construction, molded-in holes, and retainer seal treatment.

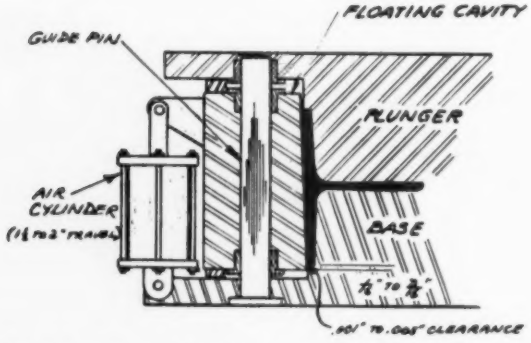

Fig. 8. Cross-sectional drawing of a floating-cavity mold.

Figure 1 shows one of the simplest types of seal; one that is easy to machine and, therefore, inexpensive to produce. This seal for the flash-type mold is limited to molding parts from premix material having a low bulk factor, and is used for parts having thin wall thicknesses and a certain amount of draw (such as found in a bowl or cup). One of the great advantages of this type of mold is the non-critical loading during actual molding operation, since the seal offers a free discharge of excess premix material until the mold is practically closed, and the restriction becomes greater and greater. Another advantage to this type of mold is that it lends itself to automatic molding cycles, since flash is removed with the part.

Figure 2 shows the configuration of a seal which has been used with fairly good results in premix molding. It makes the mold a positive mold with vertical flash. If no outside land is used, the mold is fully positive and only the load controls the thickness of the part or the degree of mold closing. If an outside land is used, an exact loading is required at each cycle since the only path of escape for excess molding material is the mold clearance. Underloading, of course, will result in an incompletely-filled cavity. The load can be weighed to no more than 1% over the theoretical quantity without endangering the quality of the resultant part by incompletely closing the mold. The advantage of this mold is that it exerts a positive pressure over the premix, compresses it to its maximum density and, thus, develops the optimum physical and electrical characteristics of the molded parts.

Figure 3 describes a modification of the positive mold to include a horizontal flash. The same molding advantages and disadvantages found in the vertical-flash, outside-landed, positive mold are found in this design. The outside land permits an internal land of minimum area and tighter clearance, producing a very thin flash. The 45° break of the plunger in the land area is for the purpose of molding a stiff ring around the flash for easier removal from the part. This seal arrangement, amenable to multi-cavities having close clearances, required sealing only the area immediately adjacent to the part; and a relief of $\frac{1}{32}$-$\frac{1}{16}$-inch in other areas between the cavities. (See Figure 7).

Figure 4 represents a compromise between the flash mold and the outside-landed, positive mold. The cavity has been relieved with a 3-5° taper, thus allowing the plunger to exert increasing restriction on the premix when the mold closes (as found with the flash mold), yet retaining the optimum pressure obtained with a positive mold. This taper in the seal permits a flashing of 2-5% of the charge, making the weighing less critical than the positive mold.

Figure 5 shows a seal design somewhat less positive (than the seal shown in Figure 4) for the major part of the closing, but with a fully-positive action for the last 0.040-0.050 inch of travel of the mold. This design may allow for a somewhat more liberal weighing of the charge, but requires better guidance since the least amount of offset might cause damage to the seal when the sharp edges of the cavity and the plunger pass each other.

Figure 6 shows a modification of the two previous

designs (Figures 4 and 5) to obtain a horizontal flash. Notice the 45° relief of the plunger along the internal seal. This feature was described under Figure 3 for the horizontal-flash, positive mold, and is applicable similarly to this type of seal with the advantage of a less-critical weighing operation.

In most cases, an external land is used. These lands should be placed on the outer edge of the mold, with a sufficient well between the seal and the land to accommodate any material oozing out of the mold, before its entrapment between the land and the mold itself.

Ejection Mechanisms

Similar ejection devices, as encountered in phenolic or melamine molding, are suitable for premix parts, with only a few exceptions. When the premix part comes out of the mold, it frequently is soft and weak. If standard ejectors are used, they have a tendency to puncture the part. This may be remedied by increasing either the wall thickness in the area of the pin or the number of pins (or using pins of larger diameter). Whenever possible, stripper plates are used since they apply pressure over a large area of the part.

The cold clearance of the ejection pins varies between a lap fit up to 0.003- or 0.004-inch. The pin usually is guided for a length equal to 1½ times its diameter.

Ejectors should be provided for both halves of the mold, unless temperature control or design of the piece are sufficient to cause positive retention to the ejector side of the mold. This mechanical retention can be obtained by a slight back taper or small under-cuts in one-half of the mold.

It sometimes is necessary to have a part without ejection pin marks on either side of the molded piece. In such a case, it is advisable to retain the part in the cavity, because its molding shrinkage will help its removal. This may be accomplished by under-cutting the resin seal on the cavity side, as shown on Figure 7. This under-cut will retain the part in the cavity until the plunger seal has been retracted sufficiently to permit collapse of the flash. At that time, the plunger is removed and the part can be blown out of the cavity.

Another way to help retain the part in the cavity side is by altering slightly the wall thickness of the part so as to obtain a larger draft angle on the plunger than on the cavity. This design will permit freer pull-back of the plunger, and the part will tend to remain in the cavity where it can be blown out.

Cut-Offs For Holes

Internal openings or holes which do not form a reverse draft during the molding operation can be molded easily into the premix part. This may be accomplished by either of two ways, see Figure 7. Fairly small holes, up to ½-inch in diameter, usually are molded by a stationary pin pushing into the premix to within 0.001-0.005 inch of the opposite half of the mold. Larger-size holes cannot be molded without relief, since the flash area becomes too large and the localized pressure too great (causing sticking problems or localized deformation of the mold). In these instances, the premix is pinched off only in the periphery of the opening with as much as 1/32-inch relief in the center. This design technique also has the advantage of molding a slug where the opening is located that permits easy flash removal.

Floating Cavities

Deep cavities and fins usually are very difficult to fill because of improper venting. This can be overcome by designing what is called a "floating cavity." Such a cavity is shown in Figure 8. The lower seal is cleared at each cycle in the upward action of the cavity by means of side air cylinders or other ejection-type mechanisms. This clearing of the lower seal opens a free escape for the entrapped air.

The floating cavity is guided in its upward motion by over-size guide pins fastened to the base of the mold. It also is restrained from coming out with the part by a proper hold-down device restricting it to a maximum of one- to two-inch movements.

Acknowledgment

Many persons assisted in compiling the design information necessary to make this paper an actual survey of mold design for premix. The author wishes particularly to express his thanks to the following companies and individuals who have been of invaluable help: Roger B. White and William Calahan, of Glastics Corp.; Robert Brinkema, of Firmaline Products, Inc., who cooperated greatly by freely divulging their processes & tool design techniques, and providing access to their manufacturing facilities; John D. Avignone, of M. A. Cuming & Co.; Ernest J. Csaszar, of Newark Die Molding & Casting Co.; Mario J. Petretti, of Product Techniques, Inc., who furnished information on their tooling materials, processes, finishes, and designs; and P. Robert Young, of Wallace & Tiernan, Inc., for his help and guidance in compiling and editing this paper.

—THE END

World's largest reinforced plastic display is 27 feet high, and the cup has a 20-foot diameter. Tobin-Craft of Cleveland made the duo, using Ferro's glass mat and roving, gel coat, parting film, and mold wax. Glidden Co. supplied the resin. Finished jar weighs 3,800 pounds; the cup, 1,000 pounds.

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A Study of Compression Molding Pressures

How to calculate the pressures required for proper molding of compression parts.

To produce plastics molded parts successfully, the application of correct molding pressures is of vast importance. In compression molding, variations in the pressure medium not only reflect differences in the quality of the molded parts, but also affect the longevity of expensive plant equipment. Besides causing fractures in the large multiple-cavity molds, use of excessive pressure medium not only reflect differences in the presses themselves. Insufficient pressures, on the other hand, will tend to create many molding difficulties and impair the quality of the molded parts. Therefore, the means employed to develop these pressures are of vital interest to plastics plant engineers.

In the molding of thermosetting materials, there are two types of pressures to be considered: (1). the high pressures for the phenolics, melamines, and ureas; and (2). the low pressures used for molding the laminates, polyesters, and other similar compounds. Inasmuch as the high-pressure thermosets constitute the greater part of the industry, this discussion will be confined to the details involved in this phase of pressure derivation.

Compression Presses

There are two types of press generally recognized for compression molding: the self-contained machines; and the system-type presses. On self-contained presses, the problem of getting correct molding pressures is relatively simple. This type of press is constructed with automatic high and low pressure adjustments so that the operator does not have to time any control valves during the molding cycle. When the mold halves meet under low pressure, the resistance of the molding material slows down the closing speed, and the high pressure goes into effect automatically. Self-contained presses are entirely independent of an accumulator. Instead, they derive their pressure energy from individual pumps driven by individual motors. Many of these independent units use oil as the pressure fluid, and toggle action for variation in pressures. Thus, the pump acts on a small plunger which in turn opens and closes a toggle mechanism.

Where toggle action is used on self-contained compression presses, it is possible to adjust pressures to the desired figures. This operating feature is a distinct advantage over the system-type of press. The heads on toggle-action presses can be lowered or raised by merely turning the large, threaded nuts located on the top of the four guide posts (see Figure 1). Thus, it is possible to obtain a wide variation of molding pressures on the same press merely by adjusting the height of the head. The tonnage employed can be read directly from a scale located on the front of the press. If the projected land area of the cavities is known, then the actual

Fig. 1. Typical self-contained compression molding presses.

molding pressure can be determined very easily. Conversely, if the desired molding pressure is known and the land area computed, then the press can be set at the required tonnage.

Molding Pressures

On system-type presses, the problem of obtaining correct molding pressures is much more complicated. On these machines (see Figure 2), the tonnage is fixed by the line pressure and the ram area, and it is not possible to vary pressures from one die to another. Consequently, if there happens to be insufficient tonnage to take care of required molding pressures on certain large dies, these molds must be transferred to larger presses. If there is found to be too much pressure exerted on the mold, this condition can be alleviated by installing pressure pads on the die. Pressure pads add more area to the bearing parts of the mold, thereby distributing the pressure. This reduces the force per unit area and, hence, reduces the molding pressure on all meeting surfaces.

For developing the necessary pressures on system-type presses, a central hydraulic accumulator system is used. This consists of a separate power house where pumps, piping, and accumulators are installed. In order to assure steady pressure at all times, pumps of the multiple-plunger reciprocating type usually are used (see Figure 3). The rated capacity of these units depends entirely on the number of presses in operation, but there must be enough pressure available to take care of peak loads in the press room. Because pumps have a pulsating action, means must be provided to cushion this motion. To accomplish this, an accumulator is placed on the line. Thus, a reservoir of energy is kept in reserve to maintain constant and steady pressure on the presses.

Types of Accumulators

Two different types of accumulators are used to provide pressure for molding presses (see Figure 4). One type uses energy derived from compressed air. On the other type, the force required is obtained by means of heavy objects, such as concrete or cast iron, being used to weigh down the plunger. The weighted accumulator moves up and down on a head of water which is kept under constant pressure. The pumps act to raise the weight, and closing of the molding press lowers it. Hence, the accumulator weight is kept floating at fluctuating heights on all of the pressure lines in the molding plant. As pressure is used by the numerous presses, the accumulator gradually lowers to a pre-set low point. At this point, a trip valve automatically puts the pumps into action. When the accumulator reaches the top, it trips a shut-off valve, thereby causing the hydraulic fluid to by-pass the accumulator.

In this manner, a constant supply of energy is kept in reserve at all times. The plastics plant engineer is interested in determining how much actual pressure can be obtained, specifically with regard to the number of pounds per square inch at the presses. These figures are directly related to the total weight on the accumulator and the size of ram on which the weight acts to provide the required pressure on the system.

Calculating Pressures

To explain the derivation of pressure, it is necessary to assume some hypothetical figures. For example, if a certain accumulator has a total weight of 42,400 pounds, and a ram diameter size of six inches, the pressure in the line may be determined easily, as follows:

$$\text{Area of ram} = \frac{\pi(6)^2}{4} = 28.27 \text{ square inches}$$

Therefore, there are 42,400 pounds acting on an area

Photo courtesy: Molded Products

Fig. 2. Large system-type compression molding press.

of 28.27 square inches, so the actual pressure in the line must be obtained by dividing the weight by the area. In this case, the line pressure is equal to 1,500 pounds per square inch. There is a temptation to jump to the conclusion that the line pressure in this example is the actual pressure exerted on all of the molds in the various presses. This is not so, however, for there are several other factors to be taken into consideration.

On system-type presses, there usually are many different ram areas which, in turn, means that the total tonnages differ from one press to another. Furthermore, the dies used in these presses may have different dimensions. Some molds may contain only 1-4 cavities, while others may be constructed with 20-30 cavities. Inasmuch as the thermosetting compounds require mold pressures varying from 2,000-10,000 psi., additional hypothetical conditions must be assumed.

For purposes of explanation, assume that a 20-cavity mold is to be used for the production of a two-inch diameter disc. The material to be run in the die is a cotton flock-filled phenolic requiring a molding pressure of 4,000 psi. With a line pressure of 1,500 psi., the problem is to find the press with adequate tonnage for successfully molding these discs. In other words, the correct ram size of the press must be determined.

First, the horizontal pressure area of the mold should be ascertained. A batch of 20 discs with a two-inch diameter makes a total area of 62.83 square inches. If each square inch of area requires 4,000 pounds of pressure, then the total pressure required amounts to 251,320 pounds. This means that a total of 125 tons will be necessary to exert the 4,000 psi. on the entire mold. Inasmuch as a line pressure of 1,500 psi. is available, the area of the ram itself will have to be 167.55 square inches (obtained by dividing 251,320 by 1,500). It is obvious that the diameter of the press ram can be calculated very easily, as follows:

$$\frac{\pi D^2}{4} = 167.55$$

$$D = 14.5 \text{ inches}$$

It is obvious from the above figures that a press with a ram diameter of 14½ inches would be satisfactory to produce the discs from the 20-cavity mold. Actually, a larger press would be required in order to compensate for frictional losses in the hydraulic feed line, as well as for the energy required on pull-back pressure. Under the circumstances, the ram diameter size arrived at by calculation should be considered as minimum. In this particular case, a press with a ram diameter size of 16 inches could safely be recommended as the most practical.

The hypothetical example could be changed by unknown factors. For instance, the problem of mold capacity and its relationship to known available pressures is one that is quite common. Very often, molding plants are limited in their available press capacities and, therefore, are restricted in the die size that they can use. When figuring the required pressures on system-type presses, there are many variables to be taken into consideration. However, a definite relationship exists between the different forces and areas. Utilization of the following three equations will be helpful in determining any pressures, areas, or mold capacities.

(1). To ascertain feed line pressure at the accumulator when the accumulator load and diameter of the feed line pipe are known:

$$p = \frac{W}{c}$$

Where p is feed line pressure, in psi.; W is accumulator weight, in pounds; and c is cross-sectional area of feed line, in square inches.

(2). To determine ram pressure when the feed line pressure and the ram area are known:

$$P = pa$$

Where P is ram pressure, p is feed line pressure, and a is ram area.

(3). To determine mold pressure when the ram pressure and mold cavity area are known:

$$M = \frac{P}{A}$$

Where M is mold pressure, P is ram pressure, and A is mold area.

In discussing the required molding calculations for the different thermosetting materials, all figures have been based on compressing parts in a horizontal plane; i.e., pressures have been figured on projected land areas.

(*Continued on page 54*)

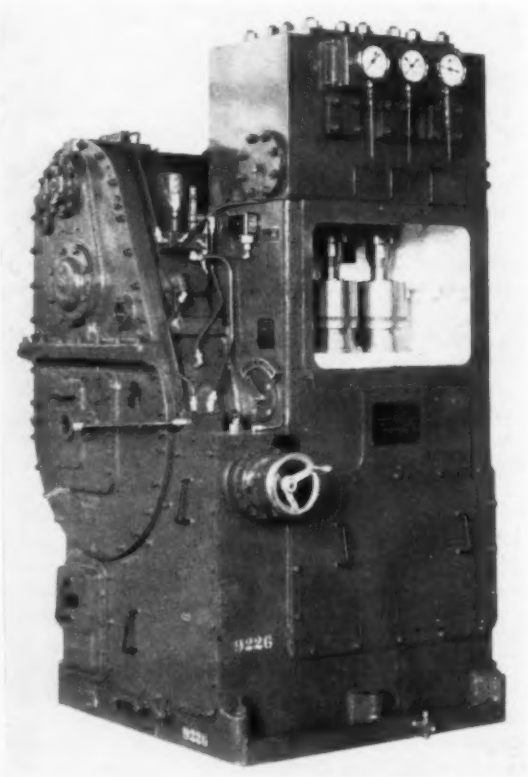

Photo courtesy: The Aldrich Pump Co.

Fig. 3. Variable-stroke, vertical Triplex pump.

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I've Got A "Secret"?

AFTER many years of writing technical articles about things plastic, we're beginning to wonder if there is really such a thing as a "secret?"

Every now and then when we're investigating the possibilities of a feature article about a new plastic material, application, or technique, we receive a very courteous "Thanks, but no. We have just started on this, and we don't want the competition to find out what we're doing," is the way it goes. Or: "Well, we don't want to talk about that just yet, because we don't want others to know how we mold this part." "Sorry, no photo-taking allowed. We can give you one of the finished product, but nothing to show what it's like on the inside," is another favorite.

There are several good reasons why we question the validity of such a policy, and actual examples may help to illustrate.

At one time, we were on the verge of writing a feature on the use of plastic as thermal insulation for an electric thermos jug. Then, somebody was bitten by the "secret" bug. "Sure, you can write about it as much as you like, and we'll give you a beautifully retouched photo of the chrome-plated product. Editors of business publications ought to be delighted with it. What, shots of the plastic being emplaced? A cut-away section? We don't want the competition to find out how we make it." In essence, this is how it went.

Now, let's examine this case. Who will buy the first 12 thermos jugs to come off the production line? The competition. And how long will it take to disassemble a jug and find out exactly, step-by-step, how it was put together? Where's the secret?

Granted, the competition might learn your techniques a month or two earlier if you write about them, but if they are really desperately interested in getting "secret" information, there's a better way than waiting for publication: hire some of your production people. It happens every day of the week.

Here's another ironic twist in the secrecy struggle. Some years ago when we were writing about the various uses of epoxy resins, we asked an automotive manufacturer for permission to visit his plant. We wanted to get photos showing the use of epoxies for stretch press dies, possibly even drop hammer dies, also jigs and fixtures. The reply was "Yup; we're using the resins. Nope, we won't allow your visit, because we don't want to divulge our methods to the others. We'd like to keep our competitive edge."

So far, so good. The same letter, "only the names were changed to protect the innocent," was sent to another automotive manufacturer, and still a third. In each case, the same comic result. "Yes, we're using it but, no, we won't tell." When you consider the consistent turnover of personnel in the automotive and aircraft industry, is it reasonable to assume that secrets long remain the property of one shop?

Still a third example; coating formulations. We can understand why an exact percentage listing of every ingredient might not be advisable, particularly where patent protection is pending or difficult to enforce. But why is there often the hesitancy even to list some of the major components? Secret? Unlikely, when most suppliers of raw materials can supply good starting formulations from which excellent paints and coatings readily are derived.

Finally, are there not some moral implications? When you read any good business publication, and most of us subscribe to several to "keep up," somebody has provided you with the results of his labors. You benefit from the new ideas he has expressed, and the new methods he has presented for your adaptation. In all fairness, if you have discovered a few improvements yourself, should you not share these with others in the same field? Does not the state of the art advance only to the extent that everyone contributes? Is it

(Continued on page 44)

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Thermoforming Biaxially-Oriented Film and Sheet

Variables in the forming operations are described, together with some of the recent equipment and package design developments.

In recent years, rapid advances in the technology for manufacturing oriented film and sheets have resulted in a line of products with new and interesting properties and, in some instances, new and interesting problems.

To capitalize fully on the advantages of oriented plastics such as polystyrene sheet and film, new methods were developed for thermoforming these relatively new members of the plastics family. As this work proceeded, it soon became apparent that the oriented sheets must be modified basically and produced under closely-controlled operating conditions to assure uniform performance. Thus, this double-pronged attack produced new methods for forming, plus a new oriented product with properties and characteristics desirable for thermoforming.

Forming Variables

The technology of vacuum forming has reached its present prominence through many years of scientific development by the manufacturers of vacuum-forming equipment and the technical pioneers who augmented this machinery with such variations as plug and ring assist, drape forming, and many other innovations. Even with all the progress and refinement of vacuum forming, it particularly was necessary to isolate and control numerous variables to vacuum-form oriented sheets successfully. The major portion of the work was concerned with oriented polystyrene sheet, but the principles developed during this study also are applicable to other oriented plastic sheets.

The dominant variables that contributed to the vacuum forming of oriented sheets were:

(1). Sheet clamping.
(2). Heat equalization.
(3). Mold temperature.
(4). Cycle timing.
(5). Speed of drape.
(6). Adequate vacuum.

Sheet Clamping

Oriented thermoplastic sheets, by their very nature, require a strong, even pressure in the clamp frame to restrain the sheet as heat is applied to obtain optimum forming temperatures. As the oriented sheet is raised to the forming temperature, stresses introduced in the manufacture of the sheet come into action, and the sheet exerts pressure up to 250 psi. in an effort to re-

Based on a paper which, in its original form, was presented at the 15th ANTEC, SPE, held in New York, N. Y., January 1959.

turn to its original extruded dimensions. Fortunately, most commercial vacuum-forming equipment is equipped with strong, adequate clamping.

One common practice is to have the clamp frame tapped for set screws which are inserted at strategic points on the frame to equalize and adjust clamping pressure. On equipment which has inadequate clamp-frame design, a new frame can be installed at nominal cost. Sponge rubber frequently is attached to the underside of the top clamp frame to act as a cushion in equalizing the clamp pressure.

Heat Equalization

Even distribution of heat over the entire sheet is of paramount importance to assure strong, uniformly-formed parts. Here, again, the peculiar properties of oriented sheets exert their influence. A localized hot spot tends to thin-down the area affected since the increase in local temperature puts into play the high stresses which have been built into the sheet.

Calrod heaters have proved satisfactory if maintained in good condition so that "dead" areas are avoided. Thermal control mechanisms should be capable of maintaining uniform temperatures (± 10°F.) to avoid heat surges.

Simple but effective screening techniques have been developed to assist in heat equalization. Wire screen, ¼-inch square in size, is most effective, but the proper size and shape of the screen can be established with a few trials. To increase sheet temperature in selected areas, such as the front of the mold which has the least thermal in-put, nickel-plated steel strips are attached to the mold base (see Figure 1) and the angle adjusted to reflect heat to those sheet sections where it is needed to obtain heat uniformity over the sheet surface.

These refinements are not necessary on all molds, but the judicious use of screening and reflectors can make the difference between complete and partial success. The importance of avoiding drafts has not been mentioned on the assumption that this is a good standard practice in vacuum forming and is common to all competent vacuum formers. Here, the use of aluminum foil around the side-walls of the forming machine has been found very effective.

Mold Temperature

Another refinement that helped to advance vacuum-forming techniques is mold-temperature control. In extreme cases, the mold can be cored and the temperature adjusted by heating or cooling water, as needed.

With oriented polystyrene sheet, the optimum mold temperature is 150-170°F. Fortunately, this temperature range is maintained during the normal vacuum forming cycles. The one precaution to be observed is to heat the mold to operating temperature (160 ± 10° F.) prior to forming the parts.

Cycle Timing

The interval-timing cycle must be controlled automatically so that the sheet is formed exactly when it reaches maximum forming temperatures. Timers must be sufficiently accurate so that the cycle is controlled within one-half second. Thus, the cycle must be controlled accurately so that the exact required dwell-time under the heater is obtained and the air evacuated at the proper interval to initiate the forming cycle.

Speed of Drape

Oriented sheets should be moved into the mold quickly by applying the vacuum as quickly as possible after forming temperatures have been attained. The clamp frame should be adjusted so that the sheet is not more than one inch above the mold during the heating cycle, and the drape speed should be set to drape the sheet rapidly over the mold. A quick-acting valve and a large (three-inch O.D.) pipe to the surge tank are necessary to produce the quick drape-speed needed.

Adequate Vacuum

The vacuum system should be capable of producing a vacuum of 28-30 inches (mercury gage). If the available vacuum is much lower than this range, it is not possible to obtain uniform parts from one cycle to another, or within each individual sheet.

Orientation Stresses

Concurrently with improvement in the technology of vacuum forming, a concerted program was initiated to determine the effects of orientation-stress variables on the ease and uniformity of vacuum forming.

Biaxially-oriented sheets are manufactured by stressing the extruded sheet in both the direction of extrusion and the transverse direction, followed by cooling of the sheet while it is still under stress. This molecular orientation markedly increases the strength and toughness of the sheet. The amount of stress developed in the sheet can be varied by proper control of the variables concerned with this process.

Oriented polystyrene manufactured under normal procedures had an orientation stress range of 125-260 psi. The results of this study indicated two things: a lower orientation average-stress level and a narrower-range orientation stress was necessary. It is beyond the scope of this paper to analyze the many details involved in the development of a special forming-grade of oriented polystyrene. However, large-scale production of this special grade of oriented film demonstrated the validity of this hypothesis.

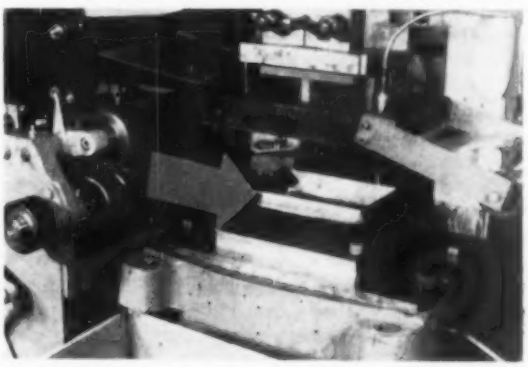

Fig. 1. Nickel-plated steel strips attached to mold base to reflect heat and obtain heat uniformity over the sheet surface during vacuum forming.

Planned research and industrial evaluations on the effects of a controlled lower-level orientation stress were evident, and the uniformity of formed parts was improved to a commercially-acceptable level. The primary factor responsible for this result was the equality in balance of the orientation stress. An equally important result was a decisive improvement in the ease and speed of forming and the greater detail and conformity to the molds.

The lower limits of minimum orientation stress possible without introducing brittleness have been established fairly well, and the processes modified and refined to manufacture consistently oriented polystyrene which can be formed with ease and constantly at high rates.

Forming Equipment

Rapid advances also have been achieved in the commercialization of formed oriented sheets through the development of pressure-forming equipment. This machinery differs in two basic principles from conventional vacuum forming. The plastic sheet is heated by intimate contact with a heating platen (as opposed to radiation heating in vacuum forming), and air pressure forces the sheet into the mold at 100-250 psi.; vacuum forming utilizes atmosphere pressure (14.7 psi. maximum).

These departures from standard vacuum forming impart two definite advantages: (1). contact heating results in a very uniformly-heated sheet surface; and (2). the higher pressures used in forming permit more faithful reproduction of the mold contours. Thus, more intricate shapes can be formed with this equipment.

This equipment normally is roll-fed, but can be modified for sheet feeding, if desired. The equipment presently available has a forming area from 9 by 11- to 24 by 30-inches, and can operate at 5-25 cycles per minute. The speed of the cycle depends on the complexity and size of the mold, thickness of sheet, and type of plastic used. As an example of the efficiency of the equipment, one-ounce portion jelly containers (1¼ x 1¼ x ½-inch in size) are being formed in batches of 120 and up at a rate of 43,200 pieces per hour.

The stages of the cycle are as follows:

(1). The stock is fed to the press at the top of the stroke and the press closes, locking the sheet in place.

(2). Air then is blown into the mold cavity, forcing the sheet firmly against the heating pad.

(3). At the completion of the heating cycle, air is discharged from the mold cavity.

(4). Air then is forced against the other side of the sheet, blowing the sheet into the mold cavity.

(5). The press then reverses its direction to the top or open position, and the formed portion of the sheet moves out of the press.

Conclusions

It is anticipated that utilization of oriented thermoplastic sheets and films will expand at an accelerated pace. This growth potential represents a challenge to all of us concerned with the packaging industry, from the polymer chemist to the packaging engineer. New, oriented polymeric sheets are being developed which will be complimented by machinery advances offering faster rates and greater versatility to meet the growth technical and economic needs of consumer and industrial packaging.

New and revolutionary package designs already are on the market, and many more are on the drawing board. They demonstrate both the ability and ingenuity of the packaging engineer. This triumvirate of materials, equipment, and designs has had a demonstrated history of success in the plastics industry. Therefore, it is with confidence that a forecast of monumental achievements can be prophesized for plastics in packaging.

—THE END

I've Got A Secret?

(Cont'd. from page 41)

justifiable to take ideas and suggestions, without offering a few in return?

Well, so far only negative reasons. How about four positive reasons for being less reticent in matters of interest to the technical press?

First, a feature article in a leading business publication enhances the stature of the individual who wrote it. Authorship is a proven stepping-stone on the road to professional success for the plastics engineer.

Second, and by the same line of reasoning, a company mention in the by-line or body of an article helps to establish it as a source of sound technical data, a company to turn to for help when help is needed.

Third, assuming that secrets indeed are hard to keep, why not take the credit for being the first to figure things out? If you wait until the competition gets the know-how, you may be sure that they are more alert to its publicity potential, and will exploit it to the fullest. Then your only remaining course is to come along and say, "me, too." By that time, someone else has stolen your thunder.

Fourth, a company that consistently appears in the business press with new ideas, new developments, or new methods comes to the attention of engineers who depend on these publications to keep them up-to-date with the latest state of the art. Engineers, like most others, like to be associated with the leader. Therefore, whom will they approach first when they are looking for new fields to conquer: the company that never has anything to say, or the one that repeatedly shows its leadership in print?

Lest we be completely misunderstood, we should like to stress that we are *not* suggesting that you reveal vital data prior to filing an application for a patent. We are advised by a leading patent counsel that this procedure is not recommended, as it may lead to expensive litigation later on to establish a prior claim. We do recommend, however, that you carefully examine your own security program. Evaluate the many advantages and, wherever possible, decide to let the world know about the many things you are doing. In most cases, the small loss in "secrecy" is more than offset by the gain in industry leadership. —THE END

C. B. Sias

T. H. Beals

T. G. Tan

Effects of Molding Variables on Reinforced-Plastic Products

Results of a definitive test program on glass-polyester parts made in matched-metal molds.

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THE ever-present variables encountered in matched-metal molding make it difficult to determine the influence of any one variable on physical properties of the molded parts. However, statistically-designed experiments make it possible to determine the more influential variables, and it is felt that reasonably accurate conclusions may be drawn as to the effects of molding temperature on the physical properties of reinforced-plastics parts.

Initial Series

Molding temperatures influence the type and degree of resin, cure, but usually do not affect the reinforcement. Thus, the physical properties most dependent on the resin should give the optimum data for analysis. Compression strength and water-absorption characteristics are dependent almost completely on the resin and the resin-fiber bond, and were considered to be most useful in an evaluation of this type.

Flexural strength and flexural modulus were included because they also depend on the resin properties, are easily determined, and have considerable meaning in the reinforced-plastics industry. The loss in strength on boiling or soaking in water is an excellent indication of the service-life characteristics to be expected of reinforced-plastics parts. The evaluation data, therefore, were obtained from wet and dry flexural, compression, and water-absorption tests. Since tensile strength depends primarily on the reinforcement, tensile tests were not considered in this work.

Experimental Procedure

Carefully planned and controlled conditions are required if maximum data are to be obtained from a series of experiments. A preliminary series of moldings was felt to be desirable to establish a practical set of operating conditions, including cure

Table 1. Influence of Resin Reactivity, Monomer Content, and Cure time on Physical Properties of Mat Laminates.

Maleic Content, %	Test*	25% Styrene Monomer, Cured for		35% Styrene Monomer, Cured for	
		One Minute	Three Minutes	One Minute	Three Minutes
100	A	38.0	35.8	32.3	27.6
	B	1.17	1.07	0.99	0.84
	C	28.2	22.5	26.2	25.0
	D	0.92	0.82	0.83	0.88
	E	24.3	21.6	22.9	23.6
	F	16.1	13.0	17.9	16.1
	G	0.394	0.710	0.425	0.432
60	A	30.8	30.0	36.6	30.0
	B	1.10	1.25	1.18	1.12
	C	27.5	27.3	29.1	17.9
	D	0.97	0.99	0.99	0.96
	E	30.3	27.0	23.7	28.8
	F	20.0	21.0	19.9	19.8
	G	0.191	0.177	0.206	0.212
50	A	33.5	38.1	20.5	33.5
	B	1.16	1.28	0.92	1.11
	C	29.0	30.9	29.1	28.8
	D	0.96	1.12	0.90	0.95
	E	31.7	27.3	24.0	26.5
	F	21.9	21.5	20.6	19.6
	G	0.169	0.140	0.175	0.212

* Code for tests: A—Flexural strength, psi. x10³; B—Flexural modulus, psi. x10⁶; C—Flexural strength after two-hr. boil, psi. x10³; D—Flexural modulus after two-hr. boil, psi. x10⁶; E—Compression strength, psi. x10³; F—Compression strength after two-hr. boil, psi. x10³; G—Water absorption after 24 hrs., %

Table 2. Influence of Filler Type and Quantity, and Catalyst Type and Quantity on Physical Properties of Mat Laminates.

Filler			Lauroyl Peroxide		TBP	
Name	Content	Test*	0.5%	1.0%	0.5%	1.0%
Atomite	20%	A	30.3	24.7	36.0	33.5
		B	1.05	1.29	1.39	1.31
		C	24.3	28.7	32.7	31.8
		D	0.94	1.01	1.10	1.17
		E	23.7	25.9	35.9	33.8
		F	21.0	21.7	35.0	32.3
		G	0.196	0.181	0.140	0.123
	35%	A	33.3	34.1	35.6	31.2
		B	1.33	1.38	1.37	1.50
		C	29.1	28.0	29.3	24.8
		D	1.10	1.04	1.17	1.13
		E	25.8	29.4	35.8	35.1
		F	21.4	21.1	34.9	34.1
		G	0.185	0.173	0.099	0.126
ASP-400	20%	A	29.2	30.8	32.6	40.2
		B	1.10	1.20	1.13	1.45
		C	22.0	24.1	30.2	35.6
		D	0.82	0.87	1.03	1.19
		E	21.1	26.0	32.6	33.5
		F	14.8	18.1	30.1	31.6
		G	0.266	0.241	0.160	0.162
	35%	A	29.1	32.6	35.0	34.1
		B	1.07	1.27	1.28	1.32
		C	20.6	25.4	30.4	29.5
		D	0.79	1.00	1.06	1.10
		E	20.1	25.4	32.0	29.3
		F	12.9	17.7	28.3	27.8
		G	0.354	0.234	0.149	0.144

* Code for tests: A—Flexural strength, psi. x10³; B—Flexural modulus, psi. x10⁶; C—Flexural strength after two-hr. boil, psi. x10³; D—Flexural modulus after two-hr. boil, psi. x10⁶; E—Compression strength, psi. x10³; F—Compression strength after two-hr. boil, psi. x10³; G—Water absorption after 24 hrs., %

time, resin composition, styrene content, filler type and content, catalyst type and concentration molding procedures etc. The number of variables to be considered made it necessary to set up and run two preliminary experiments to obtain the data and information needed to establish design limits for the major or final series of moldings.

A flat 12 x 12-inch, chromeplated, matched metal mold was used to prepare the test panels. The mold was mounted on steam-heated platens in a press operating at a ram pressure of 60 tons. The press-closing time was held constant at 14 seconds including a ½-inch slow close. Stops were used to hold the panel thickness at 0.10-inch, and the temperature was varied by controlling steam pressure. A pyrocon temperature indicator was used in the determination and control of the mold-surface temperature to ± 3° F. over the range of the experiment.

Three varying-reactivity, low-styrene content molding resins were prepared especially for this work. The procedure used in preparing panels for both the preliminary and final series of moldings was as follows: The resin first was catalyzed and thinned with styrene, when necessary. Next, the filler was added and mixed for 10 minutes with moderate agitation. The mixed resin was allowed to stand and deaerate for approximately one-half hour before molding. The moldings for the preliminary series were made with one ply of two-ounce and two plies of 1½-ounce T-219B glass mat. The mats were cut to 13- x 13-inch squares to insure adequate glass for the cut-off. The mat-resin layups were made with a ply of 1½-ounce mat on the bottom, followed by the ply of two-ounce mat. A calculated quantity of filled resin was spread over the two-ounce mat and the second ply of 1½-ounce mat was placed on top. The lay-up then was positioned in the mold, and cured according to the programmed schedule.

Glass content of the panels in the first series of moldings was found to be 30±5%. Glass distribution in the 1½-ounce mat was poor, and it was felt that the more uniform two-ounce mat on hand would give better results than the 1½- and two-ounce mat combinations. The final series of moldings was prepared using lay-ups of two pieces of two-ounce mat with the resin spread between the plies. These panels had a glass content of 26±3%. Burn-out tests on the moldings gave good agreement with the glass contents calculated from the materials charged into the mold.

The moldings were made without mold release agent, and no sticking was encountered. Three moldings or replicas were prepared at each set of conditions, and two of the panels were tested to give a basis for estimating error and to give a measure for variance. Test specimens were cut from the panels in a uniform pattern. Five specimens were run for each test from each panel, with the exception of the water-absorption tests which required only three specimens from each panel.

Experimental Results

The first preliminary experiment included a study of resin reactivity, styrene content, and curing time. A medium-reactivity resin is considered to have maleic as 50% of the acid portion of the polyester, while a high-reactivity resin contains 100% maleic. The maleic content of the resins was varied at the 50, 60, and 100% levels, and styrene contents of 25 and 35% were used. The resins were catalyzed with 1% BPO, and filled with 20% ASP-400. The panels were cured for either one or three minutes at 250° F. Physical properties of the moldings in this experiment are given in Table 1.

Conclusions drawn from this series by the analysis of variance showed that a propylene maleate-phthalate resin with a 60-40 maleic:phthalic ratio gave better results than the 50:50 or using 100% maleic resins. The resin reactivity was considered to have a major influence on properties of the moldings. The styrene content of the resin also appears to have a significant effect on physical characteristics of the molded panels. Styrene concentrations near the theoretical amount (approximately 26% for the 60:40 resin) gave better results than higher styrene contents where copolymerization is not possible for a considerable portion of the styrene. A one-minute cure was found to be adequate under the conditions of this experiment.

The moldings in the second preliminary experiment were prepared under the same conditions as those in the first. Results of these tests are given in Table 2. The 60% maleic resin at 25% styrene content was used with two less-popular molding catalysts; aluroyl peroxide and tertiary butyl perbenzoate (TBP). These catalysts were used at two concentrations; ½ and 1%. Acarbonate versus clay filler comparison also was made using Atomite and ASP-400 at 20 and 35%, by weight, of the mix.

Analysis of these data indicates that TBP gives better results than lauroyl peroxide in the molding operation. Concentration of the catalyst did not appear to have a significant effect on the results. The carbonate filler gave somewhat better results than the clay, although this was not felt to be a major factor. The concentration of filler over the range studied did not appear to have an influence on the physical properties.

Conclusions from the preliminary work were used as a basis for setting up the final series of moldings which included four temperatures, two catalysts, two styrene contents, and two curing times for a 4 x 2 x 2 x 2 fixed series full factorial design. Panels were molded at four different temperatures; 22, 250, 280, and 310° F. Since curing times longer than one minute appeared to have little influence in the first series of tests, ½- and one-minute curing times were selected for the major series. The carbonate filler was used at the 35% level.

A statistical comparison of the two preliminary experiments indicated that TBP would be somewhat preferred to benzoyl peroxide (BPO) as a molding catalyst, and so both catalysts were used at the 1% level. The styrene concentration also was influential in the initial experiment, and was included in this series at 25 and 35% concentrations in a 60% maleic resin. Results of the final series of moldings are reported in Table 3.

The experimental data were analyzed statistically to isolate and evaluate the effect of the various "operating conditions" on the measured properties.

Table 3. Influence of Cure Temperature, Cure Time, Catalyst Type, and Styrene Content on Average Physical Properties of Mat Laminates.

Catalyst		Styrene	Test	Cured at 220° F.		Cured at 250° F.		Cured at 280° F.		Cured at 310° F.	
Type	Conc.	Conc.	Code*	½-Min.	One-Min.	½-Min.	One-Min.	½-Min.	One-Min.	½-Min.	One-Min.
BPO	1%	25%	A	N	29.5	29.4	30.1	36.5	29.9	32.3	30.6
			B	o	1.50	1.33	1.34	1.48	1.37	1.48	1.40
			C	t	32.5	29.7	31.9	28.4	29.7	24.4	28.4
			D	C	1.37	1.21	1.32	1.24	1.22	1.08	1.17
			E	u	35.6	33.4	34.8	27.6	33.6	26.6	30.1
			F	r	27.2	25.2	26.4	21.0	22.2	19.6	21.6
			G	e	0.142	0.150	0.153	0.452	0.190	0.231	0.390
				d							
			A	N	30.8	25.1	31.2	31.6	27.1	28.9	32.6
			B	o	1.38	1.16	1.27	1.38	1.31	1.26	1.43
			C	t	33.0	28.8	28.8	31.6	24.4	28.9	24.7
			D	C	1.31	1.17	1.07	1.24	1.06	1.18	1.10
			E	u	31.5	29.5	28.7	30.7	29.5	29.1	27.0
			F	r	25.4	24.4	23.6	24.3	23.7	21.4	20.1
			G	e	0.263	0.234	0.214	0.180	0.224	0.272	0.170
				d							
TBP	1%	25%	A	N	N	N	35.2	31.9	34.5	38.7	34.5
			B	o	o	o	1.58	1.49	1.65	1.74	1.57
			C	t	t	t	32.3	30.3	31.3	31.4	30.2
			D	C	C	C	1.25	1.27	1.34	1.28	1.19
			E	u	u	u	36.2	33.8	34.1	32.5	30.5
			F	r	r	r	28.5	26.8	26.1	24.8	19.5
			G	e	e	e	0.176	0.199	0.205	0.226	0.452
				d	d	d					
		35%	A	N	N	N	31.2	34.0	32.9	25.2	31.8
			B	o	o	o	1.20	1.44	1.59	1.27	1.29
			C	t	t	t	27.7	22.7	27.9	30.7	26.3
			D	C	C	C	1.19	0.98	1.23	1.20	1.13
			E	u	u	u	33.1	24.5	30.2	25.3	25.2
			F	r	r	r	28.3	17.9	25.4	19.5	17.6
			G	e	e	e	0.236	0.838	0.237	0.841	0.509
				d	d	d					

* Code for tests: A—Flexural strength, psi. x10³; B—Flexural modulus, psi. x10⁶; C—Flexural strength after two-hr. boil, psi. x10³; D—Flexural modulus after two-hr. boil, psi. x10⁶; E—Compression strength, psi. x10³; F—Compression strength after two-hr. boil, psi. x10³; G—Water absorption after 24 hrs., %

Each property was analyzed separately by the "analysis of variance" technique. This statistical procedure establishes a comparison between the individual variants and an arbitrarily assigned or estimated experimental error, thus determining the level of significance of each variant.

The following conclusions were drawn from the major series of tests:

(1). Increasing molding temperatures reduces wet and dry compression strengths and wet flexural strength, while increasing the water absorption of the molded part. Dry flexural strength and flexural modulus were not shown to be influenced excessively by the molding temperature. The major effect of the molding temperature on wet and dry compression—and wet flexural strengths, as well as on the water absorption is apparent from the slope of the curves in Figure 1. The minor influence of molding temperature on dry flexural strength and wet and dry flexural moduli is obvious from the almost horizontal curves in Figure 2.

The pronounced drop in compression strength and 100% increase in water absorption resulting from the molding temperature increase definitely point out the unsatisfactory cures obtained at higher molding temperatures. Lowered compression values would be apparent immediately in use, and it is probable that the water absorption increases would indicate that poor aging characteristics and service results could be expected from parts molded at higher temperatures. It would appear, therefore, that the lowest molding temperature giving a complete cure in the allowable curing time should be used if optimum physical properties are desired.

(2). Severe delamination and/or blowing occurred on panels molded at both the high and low temperatures, indicating that the 220-310° F. range is a practical limit for molding operations. The TBP catalyzed resin did not cure at 220° F., or in ½-minute at 250° F. Resins catalyzed with either BPO or TBP resulted in blistered panels with the ½-minute cures at 310° F., even though the same curing times gave no blisters at 280° F. This blistering probably was caused by the temperatures exceeding the boiling point of the styrene monomer. Reduction of curing time to less than one minute should be made only after thorough evaluation of the resulting parts.

(3). Catalyst comparison data indicate that the dry

Table 4. Effect of Mold Temperature, Styrene Content, and Resin Reactivity on Average Physical Properties and Variance Coefficients (CV) of Test Panels.

% Content of		Test	Cured at 240° F.				Cured at 260° F.				Cured at 280° F.			
			PPG		Reco		PPG		Reco		PPG		Reco	
Styrene	Maleic	Code*	Aver.	Cv, %	Aver.	Cv, %	Aver.	Cv, %	Aver.	Cv, %	Aver.	Cv, %	Aver.	Cv, %
25	30	A	31.2	9.8	N		39.2	12.7	N		33.4	15.8	N	
		B	1.26	2.7	o	M	1.22	10.2	o	M	1.21	6.4	o	M
		C	29.1	10.6	t	o	27.4	8.1	t	o	29.7	10.7	t	o
		D	1.16	8.9		l	1.08	7.2		l	1.08	5.3		l
		E	34.1	4.7		d	21.5	13.5		d	25.3	5.8		d
		F	22.3	7.7		e	21.3	7.3		e	17.0	10.0		e
		G	0.110	—		d	0.118	—		d	0.116	—		d
	50	A	34.0	10.3	32.8	9.4	33.9	13.5	34.0	24.0	35.5	12.2	35.2	15.5
		B	1.46	5.5	1.41	10.7	1.49	9.7	1.57	12.6	1.55	7.5	1.63	8.2
		C	31.9	13.3	31.2	5.8	28.3	9.4	29.2	6.6	31.8	7.9	33.7	4.5
		D	1.36	8.1	1.33	3.9	1.20	4.6	1.23	8.1	1.29	7.0	1.40	8.6
		E	29.5	9.7	33.8	5.4	33.4	8.8	29.1	4.4	33.9	5.2	29.8	4.8
		F	27.3	6.5	28.8	5.1	23.3	7.6	21.0	6.9	25.5	8.0	24.5	5.1
		G	0.086	—	0.171	—	0.101	—	0.193	—	0.117	—	0.115	—
	60	A	29.6	11.5	34.0	17.6	30.2	12.6	33.6	14.6	30.3	8.1	35.4	17.2
		B	1.40	5.1	1.45	7.7	1.51	4.5	1.47	3.2	1.46	3.4	1.64	10.5
		C	26.8	9.1	31.0	9.0	27.1	8.3	29.4	6.1	28.2	9.2	29.9	8.3
		D	1.12	5.4	1.31	4.9	1.16	8.2	1.20	5.0	1.13	6.3	1.34	7.7
		E	32.6	2.5	33.6	6.7	34.0	9.3	30.2	5.4	32.0	9.7	33.8	9.2
		F	24.3	5.3	29.2	9.4	23.5	7.2	18.8	5.0	19.9	8.6	14.7	6.7
		G	0.141	—	0.154	—	0.140	—	0.234	—	0.197	—	0.537	—
	70	A	33.6	11.2	32.4	8.5	30.3	7.3	27.9	14.5	28.4	11.4	29.5	5.2
		B	1.36	5.4	1.46	6.2	1.38	4.2	1.37	11.3	1.29	10.6	1.35	5.7
		C	31.0	10.7	32.4	11.9	29.1	9.3	25.2	15.9	26.8	10.9	25.0	8.4
		D	1.27	3.4	1.29	9.7	1.16	6.5	1.15	9.0	1.09	9.8	1.06	6.5
		E	32.8	14.0	31.5	5.5	32.1	9.7	31.8	3.5	32.8	2.6	27.3	15.8
		F	26.6	5.3	26.2	4.8	19.2	5.2	19.1	8.6	20.7	10.3	19.8	15.0
		G	0.160	—	0.128	—	0.193	—	0.373	—	0.346	—	0.472	—
40	50	A	30.2	11.4	29.4	7.6	31.4	5.8	28.6	7.7	30.9	11.1	27.7	6.8
		B	1.12	6.1	1.17	8.1	1.25	4.4	1.15	4.9	1.33	4.3	1.17	8.8
		C	26.8	13.6	28.7	8.7	28.5	7.8	30.6	8.3	29.0	5.1	27.6	14.8
		D	1.10	7.0	1.15	9.4	1.19	6.2	1.24	7.6	1.22	7.5	1.14	9.8
		E	26.5	9.3	27.7	9.3	28.1	2.9	24.1	5.9	26.6	10.2	26.4	5.5
		F	22.2	4.4	28.5	7.4	23.5	10.7	21.1	8.4	24.1	5.0	28.3	8.4
		G	0.167	—	0.310	—	0.135	—	0.136	—	0.148	—	0.133	—
	60	A	28.0	9.0	26.6	12.3	28.5	12.4	24.3	9.4	29.0	20.0	25.4	21.1
		B	1.13	2.4	1.07	8.8	1.23	5.1	1.10	11.4	1.20	16.5	1.06	11.8
		C	26.0	7.8	24.1	8.9	25.3	15.9	24.9	12.4	26.3	18.7	24.3	15.4
		D	1.12	9.4	0.97	1.6	1.02	13.0	1.13	9.5	0.93	17.3	0.97	10.7
		E	27.3	9.4	31.5	3.4	30.5	8.3	25.0	5.7	27.2	7.7	24.9	8.3
		F	24.6	4.5	23.0	7.3	20.7	5.6	27.8	2.6	18.9	6.3	19.8	4.8
		G	0.148	—	0.390	—	0.229	—	0.186	—	0.318	—	0.559	—
	70	A	28.6	9.4	26.9	3.8	27.0	18.0	28.1	15.8	27.7	16.0	29.9	11.5
		B	1.10	4.0	1.18	4.7	1.17	12.3	1.02	6.7	1.06	11.6	1.13	8.8
		C	26.0	11.2	23.4	13.0	26.1	9.1	28.6	5.0	24.2	11.5	25.1	28.4
		D	1.04	11.5	0.97	6.6	1.00	7.1	1.24	7.3	0.93	11.7	1.02	16.8
		E	28.5	6.3	27.3	12.8	23.8	15.6	22.8	14.0	21.6	6.1	17.8	9.2
		F	21.4	2.9	27.8	9.0	15.5	12.6	23.9	7.4	14.0	11.9	13.8	7.2
		G	0.234	—	0.348	—	0.766	—	0.291	—	1.03	—	1.45	—

* Code for tests: A—Flexural strength, psi. x10³
B—Flexural modulus, psi. x10⁶
C—Flexural strength after two-hr. boil, psi. x10³
D—Flexural modulus after two-hr. boil, psi. x10⁶
E—Compression strength, psi. x10³
F—Compression strength after two-hr. boil, psi. x10³
G—Water absorption after 24 hrs., %

flexural strength of a molding is better when tertiary butyl perbenzoate is used. Other physical properties are approximately the same when either catalyst is used. The economic advantage of benzoyl peroxide is sufficient to make its continued use recommended.

(4). Styrene content of the resin has a definite influence on the physical properties of the molded parts. Moldings prepared from resins containing 25% styrene are superior to those made with 35% styrene resin—see Figure 3. It appears that it is not desirable to add excessive amounts of styrene when the highest-quality parts are required.

Conclusions

A summary of conclusions which may be drawn

Fig. 1. Properties affected significantly by molding temperature.

from the preliminary and final molding series are as follows:

(1) The optimum temperature for molding reinforced polyester will be in the 240-260° F. range. Higher temperatures may lead to parts with inferior initial and service characteristics, while lower temperatures will require excessively-long mold times to insure a complete cure. Under any circumstance, production parts molded at temperatures greater than 260° F.

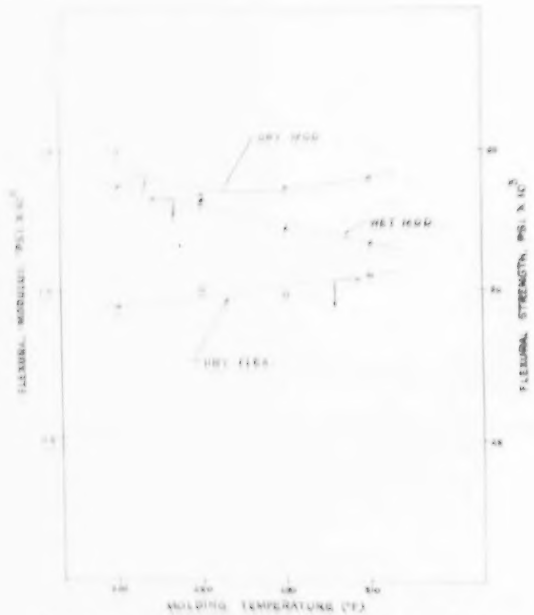


Fig. 2. Properties not affected by molding temperature.

should be tested extensively to assure their ability to give satisfactory performance, both initially and after aging.

(2) Curing times of less than one minute should be proved adequate before being used in production. Extending the cure beyond the "proved" minimum cure-time does not improve the molding.

(3) Resins with moderately high reactivity will give moldings with improved physical properties.

(4) Promiscuous addition of styrene can give poor moldings.

(5) Benzoyl peroxide is a satisfactory molding catalyst. Tertiary-butyl perbenzoate may be advantageous in high-temperature molding operations.

(6) There appears to be little choice between the carbonate and clay fillers. Also, filler concentration is not particularly significant if held within reasonable limits. The stability, handling, flow, and molding characteristics of the resin-filler mix probably will be affected more than the physical properties of the molding.

Proof Series:

A so-called "proof series" of panels, designed to confirm or reject the more important conclusions, were molded at two locations: our laboratory at Springdale, Pa., and the Reco Laboratory (Molded Fiber Glass Research Co.) at Ashtabula, O. Statistical treatment of the data showed relatively good agreement between the moldings prepared at the two laboratories, although burn-out tests showed lower (27-30%) and somewhat more uniform glass contents in the PPG panels. The initial conclusions were confirmed, and some interesting "interactions" were observed.

The more influential factors reported initially included the molding temperature, reactivity of the resin, and its styrene content. These variables were included in the proof series. Temperature and resin reactivity had been varied rather widely in the earlier work, and now were observed over a more limited range in this latter series. At the same time, the range of styrene content was increased in an unsuccessful attempt to inject a "theoretical styrene" consideration into the analysis. Thus, a three-resin (50, 60 and 70% maleic), three-temperature (240, 260 and 280° F.), two-styrene content (25 and 40%) experiment was designed and moldings were prepared in the PPG and Reco Laboratories.

Experimental Procedure

General molding conditions used in the preparation of these panels were the same as those used in the final series of the original work. Resin-filler mixes were prepared by using 65 parts resin and 35 parts carbonate filler in the low-styrene formulations, and 52 parts resin, 13 parts styrene and 35 parts filler in the high-styrene mixes. Two piles of two-ounce mat were cut to 13 x 13-inch squares, the calculated quantity of catalyzed (1% benzoyl peroxide on the resin weight) filled resin was spread between the plies, and the lay-up was molded to stops in a 12 x 12 x 0.1-inch matched-metal mold mounted in a fast-acting, adequately-

pressured press. The panels were cured for one minute at the molding temperature.

Duplicate panels were molded, although only the Springdale panels were tested in duplicate to determine the degree of error in procedures for the analysis of variance. The "error" used to determine the degree of significance of the variables was determined as the difference between the sum of the squares and the square of the sums of the variables. A significant effect was assumed when the variation was found to exceed the error 95% of the time, and a highly significant effect was assumed at the 99% level. Wet and dry flexural and compression tests, and the water-absorption values again were used as the evaluating properties.

Experimental Results

The average values of the tests and the coefficient of variation (Cv) are given in Table 4.

Examination of the data developed in the "analysis of variance" statistical treatment led to the following conclusions. Use of narrower temperature and resin reactivity ranges decreased the observable affects of these variables, while the broader styrene variations showed an increased influence on moldings. In fact, the styrene content appeared to be a highly-significant factor in all seven of the physical properties examined, while reactivity was found to be highly significant in five cases and only significant in one other case. The temperature proved to be significant or highly significant in only three out of seven properties.

These results indicate that moldings cured in the temperature range of 240-280° F. for the most part will be quite acceptable and near the optimum in physical characteristics. There is, again in this series, a good indication that somewhat poorer wet-strength retention and water absorption values will be found on panels molded at the higher temperatures.

Moldings prepared with high-styrene content resins again showed a general decrease in properties as the styrene was increased. An effort was made to analyze the data with regard to the theoretical styrene content; i.e., the styrene necessary to react completely with the unsaturation in the polyester. However, the family of curves, as well as the statistical data, did not give recognizable trends or analyzable data.

Resin reactivity again proved to be an effective variable. The general trend was toward lower properties with the higher maleic-content resins. Consideration of the quadratic variance results failed to show the expected optimum properties at 60% maleic content. A 30% maleic resin, molded at Springdale and included in the analysis after the reactivity trend was established, also seemed to indicate that the 50% maleic range is optimum.

An interesting phenomenon or interaction, as the statisticians call it, was found in this series of moldings. Interactions occur when several of the variables work together to give unpredicted results. In this case, the molding temperatures are found to be more acceptable for use with the lower activity resins, and vice versa.

This interaction is illustrated in Figure 4, where the positions of the compression strength-resin reactivity-

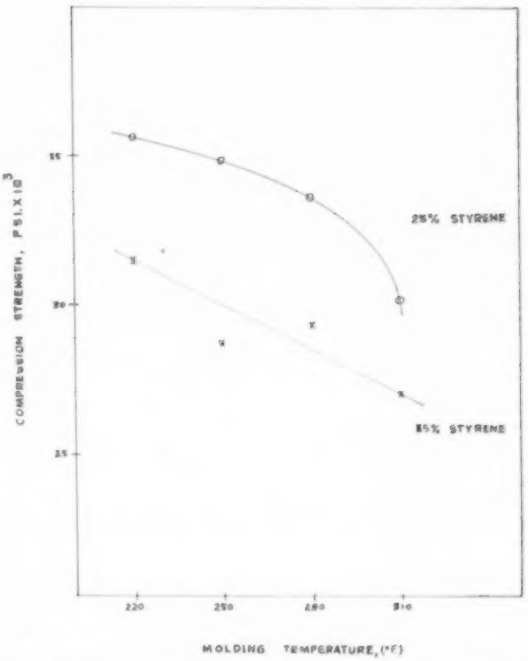
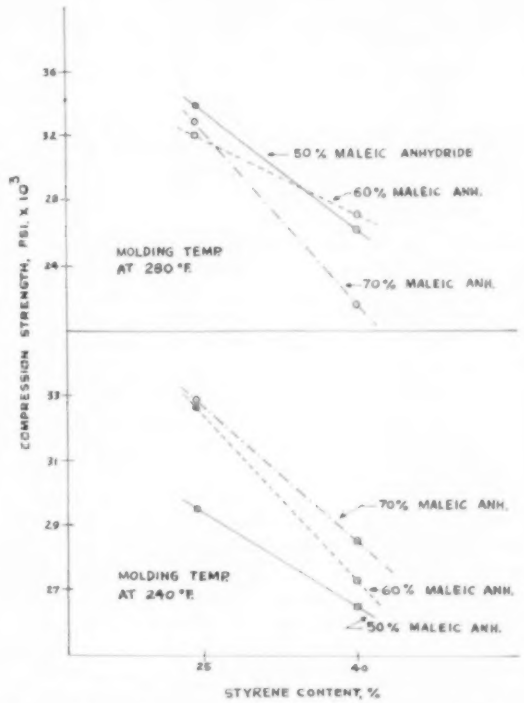


Fig. 3. Effect of styrene content on dry compression strength.



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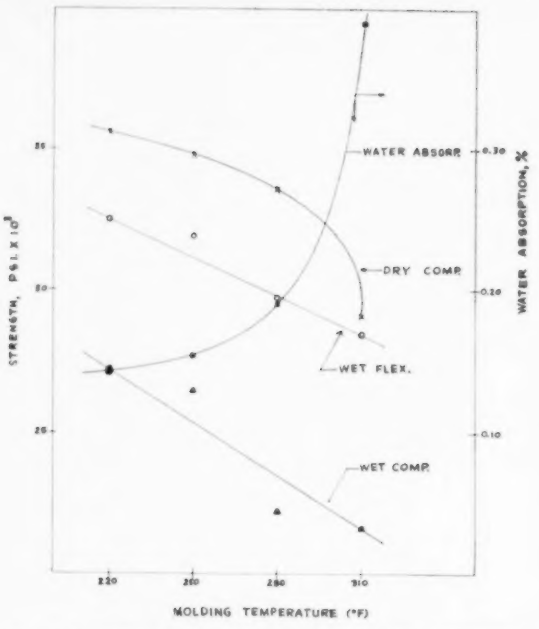

Fig. 1. Properties affected significantly by molding temperature.

from the preliminary and final molding series are, as follows:

(1). The optimum temperature for molding reinforced polyesters will be in the 240-260° F. range. Higher temperatures may lead to parts with inferior initial and service characteristics, while lower temperatures will require excessively-long mold times to insure a complete cure. Under any circumstance, production parts molded at temperatures greater than 280° F.

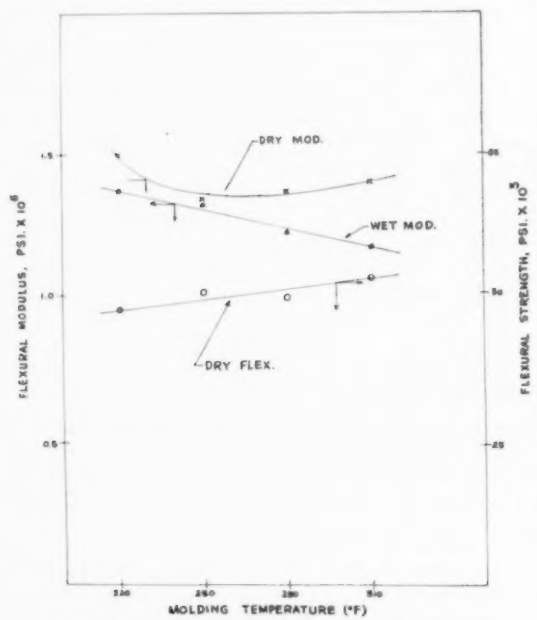

Fig. 2. Properties not affected by molding temperature.

should be tested extensively to assure their ability to give satisfactory performance, both intially and after aging.

(2). Curing times of less than one minute should be proven adequate before being used in production. Extending the cure beyond the "proven" minimum cure-time does not improve the molding.

(3). Resins with moderately high reactivity will give moldings with improved physical properties.

(4). Promiscuous addition of styrene can give poor moldings.

(5). Benzoyl peroxide is a satisfactory molding catalyst. Tertiary-butyl perbenzoate may be advantageous to high-temperature molding operations.

(6). There appears to be little choice between the carbonate and clay fillers. Also, filler concentration is not particularly significant if held within reasonable limits. The stability, handling, flow, and molding characteristics of the resin-filler mix probaby will be affected more than the physical properties of the moldings.

Proof Series

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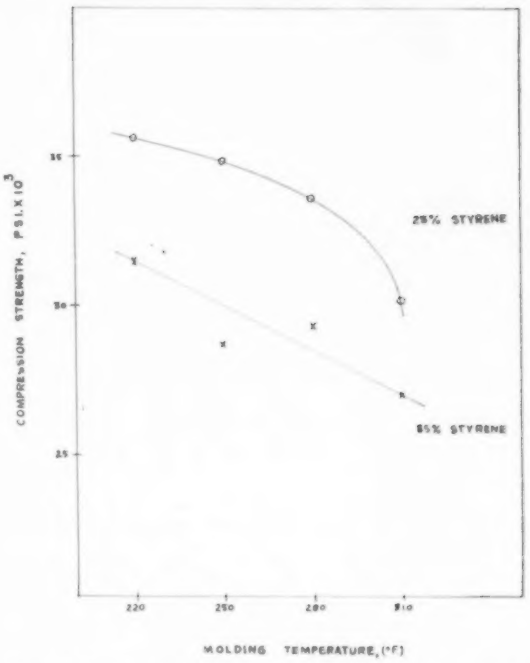


Fig. 3. Effect of styrene content on dry compression strength.

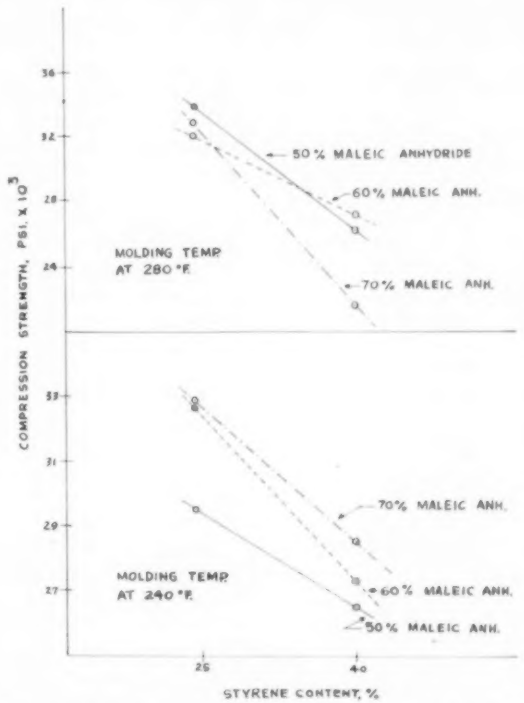


Fig. 4. Effect of styrene content, resin reactivity, and molding temperature on compression strength.

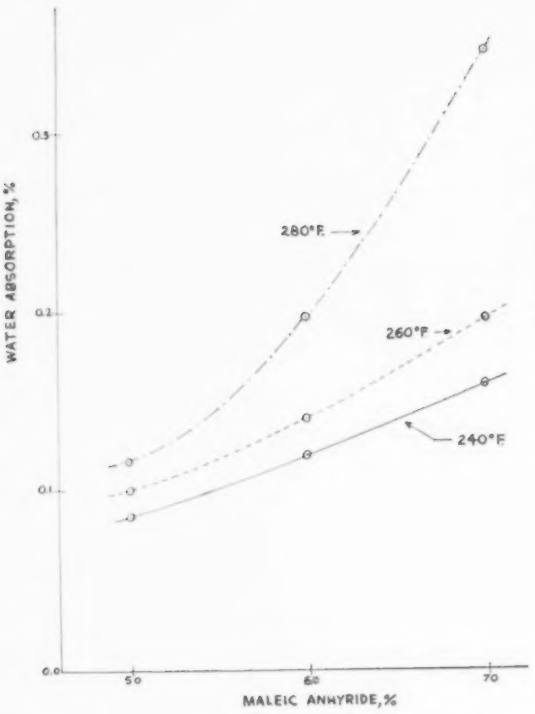


Fig. 5. Effect of resin reactivity and molding temperature on 24-hour water absorption values for mat laminates.

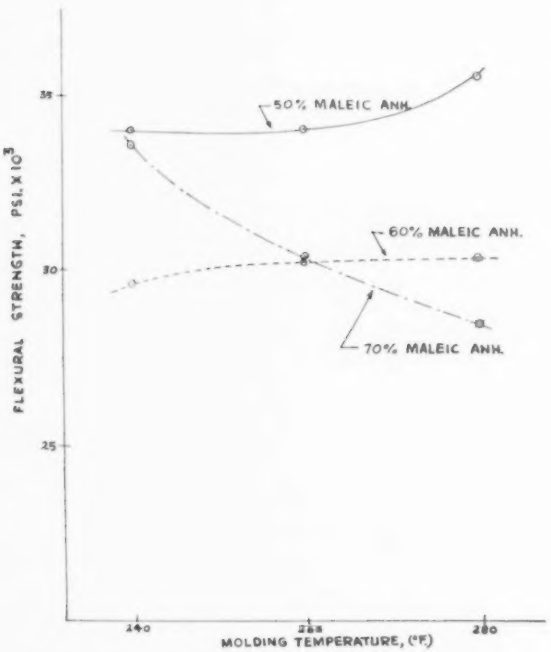


Fig. 6. Effect of molding temperature and resin reactivity on dry flexural strength values for mat laminates.

styrene content curves are found to be reversed at the high and low molding temperatures. The 50% maleic resin exhibits the lowest compression strength at the lower molding temperature, while the 70% maleic resin gives the highest-strength panels. At the 280° F. molding temperature, the positions of the 50% and 70% maleic resins are reversed. (Note that the strength scale is double in the 240° F. portion of the graph to allow the plotting of wire variation between high and low values.) The other properties tested do not illustrate this interaction as graphically as the compression strength, but prevalence of the temperature-reactivity interaction factor in the analytical results shows that such an interaction actually does exist, and may account for some of the "unexplained" variations in reinforced-molding operations.

Figure 5 shows that the water-absorption properties of the panels increase with both molding temperature and resin reactivity, with the rate of increase being higher at the higher molding temperatures. Flexural strength values were not affected seriously by the molding temperature in any of the series of moldings. Figure 6 illustrates the earlier conclusion that molding temperature has only a minor influence on flexural strength over the 240-280° F. range. The flexural strength is shown to be relatively constant over the temperature range, although the high-reactivity resin does drop off as predicted from earlier observation of the interaction between reactivity and molding temperature.

Conclusions

A summary of conclusions from the five, separate molding series included in this paper shows that styrene content, a property readily controllable by the molder, is the most influential factor or variable with regard to the physical properties of the final molded part. The second most important variable appears to be resin reactivity. Medium-reactivity resins should be used whenever physical properties are of maximum importance. The least influential major variable is the molding temperature, the original subject of examination in this paper.

As long as molding is conducted in the 240-280° F. temperature range, satisfactory properties should be obtained. The opportunity or possibility of using higher-reactivity resins at lower molding temperatures may be of interest and importance in many cases.

Physical properties, which may be reduced to numerical values and readily evaluated, have been used as the basis for the conclusions drawn from this work. Appearance is more difficult to appraise and evaluate, but it is important none the less.

The best-appearing moldings in this series were cured at 260° F., using the highest-reactivity resin at the lower styrene content. In general, increasing the styrene content of the resin increases the fiber pattern and reduces the gloss on the panel. The 60% maleic resin panels were the best of the high-styrene moldings.

To conclude, final recommendations for operating conditions which will give optimum moldings would be a 50-60% maleic resin containing 25-30% styrene, being molded in good tooling at 240-260° F. —End

ENGINEERING FORUM

Edited by:
G. A. TANNER, *Sales Mgr.,*
Auto-Blow Corp.
Bridgeport, Conn.

Blow Molding: The Trained Personnel Problem in Blow-Molding

THIS is the first in a series of columns on blow-molding by this author. If these columns are to continue, I would like to solicit the assistance of other interested parties in obtaining information, problems, and thoughts on items that might be covered in future columns.

Everyone in the plastic industry now is aware that the blow-molding portion of our field is not only the newest, but is by far the fastest-growing segment. Ten years ago, there was little, if any, plastic being molded by blow-molding. Two years ago, there were approximately 15,000,000 pounds of material processed by blow-molding. This year, that figure has increased about three times, and we should see it reach 75-million pounds annually by the end of 1960. Next year's production should be doubled within the next five years.

Unprecedented as these figures are in the plastic industry, I believe it is even more startling to consider the number of firms involved. Two years ago there were approximately 12 firms doing blow-molding. Last year, this number was increased to 25 or 30. By the end of next year, estimates show there should be as many as 200 firms engaged in blow-molding operations, and by the end of 1965, this figure probably will reach 1,000.

Today, the biggest problem of this growing industry is not the adequate production of plastic materials and equipment, but rather, the availability of trained blow-molding specialists. We have the assurance of the chemical companies that they have more than sufficient facilities to meet this expanding market. Likewise, speaking for the equipment manufacturers, I can assure you that our facilities and production can be satisfactorily expanded.

The personnel problem is a different matter. There is no great source of specialists to supervise and operate this equipment. We are continually asked by prospective customers for leads on trained people whom they may contact for employment in their plants. Persons who have acquired a knowledge of the blow-molding technique, either with a blow-molding shop, an equipment manufacturer, or a chemical company, are constantly receiving a wide variety of offers. Some of these people will move, for this is a natural process of personnel supply-and-demand, resulting in the intermingling of people and the dissemination of information. However, the majority of technicians and operators must be trained by their employers with assistance from the S.P.E., material suppliers, and equipment manufacturers.

More and more printed information is becoming available in the form of technical articles published in the trade journals. At least twelve such articles were printed in the past six months. All S.P.E. Sections with which I am acquainted are scheduling a blow-molding speaker for the coming year. The '59 ANTEC in New York scheduled a complete session on blow-molding, and there are similar plans for the 1960 ANTEC. Talks have been given at the various regional technical conferences, and papers are scheduled this month for the NATEC at Los Angeles. The information given in these papers and publications is certainly of tremendous value to untrained, semi-trained, and trained personnel.

The plastic suppliers always have maintained programs for training in injection molding and extrusion techniques. Some already are equipped to offer this service for blow-molding, and I believe that all of them plan to offer increased services in this regard in the near future.

What kind of a man would you select for this training? Of course, the more plastic-working background he has, the better are his chances for quick assimilation. Blow-molding uses techniques similar to three other phases of the plastics industry. People who are trained in injection molding will find their knowledge of materials and mold construction of great value. People trained in extrusion also will find their

(Continued on page 54)

A Study of Compression Molding Pressures

(Cont'd. from page 40)

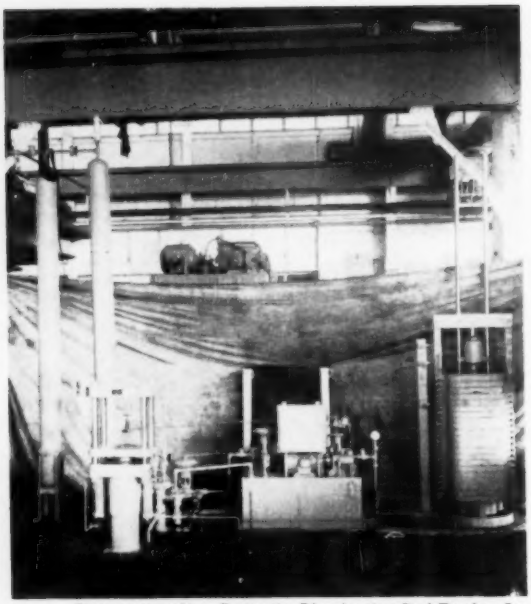


Photo courtesy: Aimes Engineering Div., American Steel Founders, Inc.

Fig. 4. Low- and high-pressure accumulator units for high-speed molding presses. Air-ballasted unit (left) for low pressure; weighted-type unit (right) for high pressure.

However, not all molded parts are discs, flat buttons, or buckles. Pressure values also must be considered in relationship to items which have deep-draw design. Parts such as cups, radio cabinets, and many other similar products often are designed with as much as five or six inches of depth. In such cases, more pressure is required to make the material flow up the sides. The generally recognized rule is to add 500 pounds to the recommended molding pressure for every inch of depth. For example, if a housing four inches deep is to be made out of a material that requires a molding pressure of 3,000 psi., then an additional 2,000 pounds of pressure should be added to gain the best results.

It seldom will be found necessary to use Equation (1) given above because the feed-line pressure usually is known. However, if weight is either added to or taken away from the accumulator, the pressure in the feed line will be changed accordingly. The most important equation to keep in mind is that which relates to mold areas, ram pressures, and molding pressures (Equation 3). While it is not always possible to place dies in presses that have the required amount of pressure, every attempt should be made to approach this condition. The results will not only ameliorate the external appearance of the molded parts, but also improve their physical properties. —THE END

Blow Molding

(Cont'd. from page 53)

knowledge of extrusion of great value, since most blow-molding operations use this principle. People who understand vacuum forming can readily translate their thinking from the forming of sheet material into a given shape by means of vacuum to the forming of tubular material into a given shape within an enclosed mold by means of air pressure. If the person involved has a working knowledge of all three of these processes, he would have the optimum training short of actual blow-molding experience.

There is a movement afoot to start an S.P.E. PAG group on blow-molding. It is within the realm of possibility that when organized, such a group could develop a formal training program for blow-molding technicians. Until such a program can be brought to fruition, it will be necessary for firms interested in entering blow-molding to train their own people, using the aids outlined above. These, with the cooperation of equipment manufacturers and plastic material suppliers, will enable them to feel their way along with the problems relating to their own product. —THE END

Tests at the University of California indicate that black polyethylene ditch liners help improve irrigation conditions.

Curbs Irrigation Problems

LINING irrigation ditches with black polyethylene film can yield improved water and vegetation control and irrigation-flow characteristics. According to tests recently completed by the University of California at Davis, in cooperation with Union Carbide Plastics Co., the liners reduced, and in some cases eliminated, such costly irrigation problems as seepage, ditch bank washouts, sloughing, and erosion. The three-year study, conducted at 22 sites with varying soil, management, and climatic conditions, evaluated the behavior of 8-mil, 4-mil, and 1.5-mil films.

In most conditions, 4- and 8-mil film may be expected to perform satisfactorily for at least three years. In one instance, seepage reduction 94% over conventional unlined plots was achieved by the 8-mil film. Eight-mil is recommended where nutgrass is a problem. If handled carefully, 1.5-mil film should last for one year. Damage to the film can be repaired easily with pressure-sensitive tape.

According to the report, the film inhibits weed growth. Furthermore, because it is smooth, the cross-sectional area of the ditch may be decreased approximately one-third when the lined section is reasonably smooth and straight.

Application of the film does not require special equipment. It can be rolled out by a pipe through the center of the roll or by using the tool bar of a tractor, and anchored at the edges and ends with soil. —END

ENGINEERING FORUM

Edited by:
R. H. Hoehn, *Chief Engr.*
Mack Molding Co., Inc.
Wayne, N. J.

Injection Molding: Your cooperation and assistance invited

"FORUM: A place or gathering for public discussion." By definition, then, this column becomes a gathering place for public discussion of matters concerning Injection Molding and all of the technology associated with that industry.

Engineering Forum columns long have been a feature of PLASTICS TECHNOLOGY, but this is the first on Injection Molding since the appointment of the new Injection Molding editor. For that reason, we have chosen to call your attention to the definition of forum. We believe that the forum concept is the ideal format for this column. It follows, then, that you, our readers, are the members of the forum, and we suggest that you, as individuals, take maximum advantage of the facilities of this column to exchange information with your counterparts throughout the country. Your editor relies on the comments, suggestions, and case histories submitted by readers of this column to provide the spark of spontaneity so characteristic of this forum.

Your editor is engaged in enlisting the help of several well-known individuals in the industry. They occasionally will contribute columns designed to provoke much thought and much written comment from amongst those who read them. The column always is available to others who may wish to comment either pro or con on the writings of others. It is also available for "Guest Editorials" by those who feel quite strongly about some phase of our industry. The only requirements are that your comments be constructive and of general interest to the technical personnel of the injection molding industry.

It is trite and, perhaps, unnecessary to point out that this column can be only as effective as "the members of the forum" make it. We do not hope to present here original or highly-technical papers substantiated by massive laboratory data. That job is being done very effectively by the technical service laboratories of many of the raw material suppliers, as well as by others with similar research facilities. Hardly a month goes by without the publication of data concerning the development of another "revolutionary" technique. We do not expect to make any such presentations here, but rather feel that our chief function should be to serve as a sounding board to report on industry experience with some of these new techniques, as well as with some others not so new. Oftentimes that which looks so promising in the laboratory is a complete failure in the field. Case histories, both successful and unsuccessful, would be of immeasurable value to our readers. Any information of this nature that you report on will constitute a real contribution to the technological development of our industry. This column exists for that sole purpose. Won't you help?

—THE END

Before:—Dark hallway with shadows and ceiling glare.

After:—Alsynite r-p panels diffuse light, eliminate glare.

PLASTICS TECHNOLOGY

EXPLORING FABRICATION TECHNIQUES

By L. J. ZUKOR, *Engineering Editor*

Injection molders . . .

. . . have a hybrid member in their midst. At present, he has no new name. Unlike straight custom or proprietary molders, he has increased his operation to also include the manufacture of basic raw materials. This operation that formerly was entirely the province of raw material producers, is now, with the advent of better, smaller and less expensive equipment, being adopted by the more venturesome members of the plastics molding industry.

Less than 10 years ago, no molder would have ventured into material production. Some of the deterring factors were: the secrecy of technology and operational know-how; the high cost of process equipment; the economics of small plant versus large plant operations which favored large operators in sales competition; and last, but not least, the patent structure and license agreements with their attendant toll in royalties that bound molders.

A break came when new and simpler processing methods were discovered for some of the older materials and, further, when information was increased and disseminated on polymerization catalysts. This, added to reams of graphic time-temperature charts accumulated from pilot plants and laboratories, form the basic know-how that made small plants economically possible.

One of the first molders known to have entered the material producing field is Foster Grant Co., of Leominster, Mass. This company, whose beginnings as a molder date back to the years of World War I, has in recent years successfully produced and marketed plastic materials. The firm's first major start was with the manufacture of polystyrene for which it now owns and operates both monomer and polymer plants. In a five-year period, Foster Grant has become a prime materials producer in the plastics industry, with styrene, nylon, and now acrylonitrile. Although Foster Grant can no longer be looked upon as a small producer, other smaller companies who have taken their lead from them are presently in or entering on similar operations.

Companies capitalized at little more than $500,000 are producing materials for their own consumption and offering the balance on the open market. Styrene is one of several materials that led the way. It has been polymerized commercially by all known methods of polymerization, limited only by economic factors as to which method is chosen. Of all the known methods, two are now invariably used by those entering the field. These are the suspension polymerization system (used by Foster Grant), and the batch-mass system also called

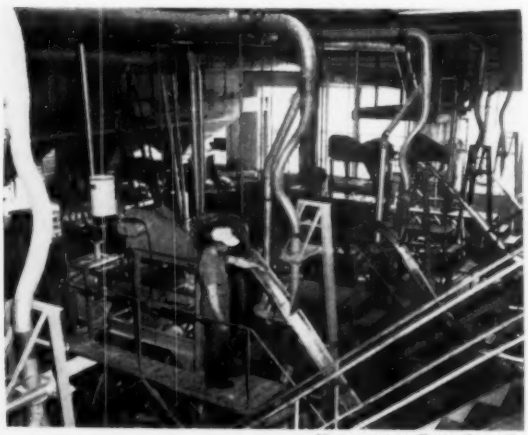


Photo courtesy: Foster Grant Co.

Polystyrene pelletizing and screen sizing operations.

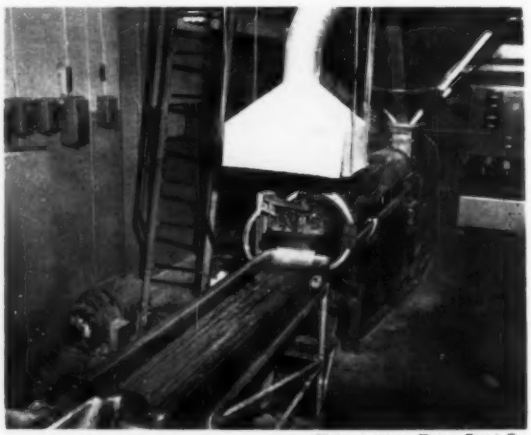


Photo courtesy: Foster Grant Co.

Polystyrene extrusion entering water bath prior to pelletizing.

the plate-and-frame method. Both systems entail a capital investment estimated at about $200,000 to equip a 4 to 6-million pound per year plant. Note that this estimate does not include plant site, plant, or other plant services.

Unlike Foster Grant, who occupies an enviable position in that it has its own monomer source, few others are in a position to undertake polymer production without a steady and continued monomer supply. It is therefore necessary for these new vertical operators, who wish to obtain a price advantage by polymerizing their own material, to insure a constant supply of monomer material for themselves. This first consideration is usually set up by long-term contract with one or more monomer producers. It is also a fact that most monomer manufacturers also polymerize and market the polymer. They are, therefore, often reluctant to supply other than polymer to prospective customers. However, as has already happened in the past with many other monomeric materials, the inducement of assured sales was sufficient to cause an increase in monomer plant capacity and output.

Another point in fact is that styrene monomer and polymer production in this country continues to show increased growth. It has not exhibited the dramatic growth that polyethylene or P.V.C. have shown, but rather a continued, steady growth pattern. New uses are being found for the high-impact variety, and its use as a co-polymer is expanding in the formation of new plastics. Some of the latest end-uses have been in the industrial field where polystyrene is supplanting metal parts in hardware applications such as door latches, drawer pulls, and instrument cases.

●

A New Method . . .

. . . for lining metal pipe and tubing with Teflon has been tested successfully at Du Pont's Chestnut Run Sales Service Laboratory. This technique involves the use of a die and chain puller or standard swaging machinery to draw the metal tube down onto the plastic liner. The cold-drawing method is believed to be applicable for the fabrication of liners of any plastic in any cold-drawable metal tube or pipe.

Plastic linings in metal pipe and tubing provide useful protection against corrosion caused by a wide variety of chemicals and fluids. The metal casing in this instance provides the bulk of mechanical strength while the plastic forms the impervious, corrosion-resistant barrier. The metal further bolsters the plastic by increasing its resistance to creep and elongation while allowing the plastic to support an increased hydraulic pressure safely.

Other linings presently being used are: metal overbraid for flexible service; plastic coatings deposited in the pipe from solvent solution; and helical laminated layers of plastic lining in metal pipe.

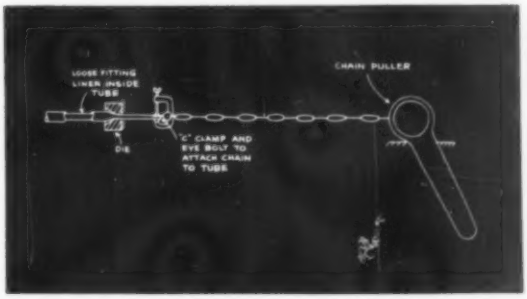
Another feasible method of lining rigid pipe with diameters up to four inches involves a technique based on prestretching a plastic liner, inserting the liner into the pipe and then relaxing it, allowing the material to snap back to provide a tight, radial bonding stress. This is possible only with plastics exhibiting elastomeric qualities, and is impractical for long lengths of pipe and for diameters below one inch.

The metal cold-drawing technique described was developed as a means to overcome the above shortcomings, while achieving identical, compressive bonding with simple tube-drawing procedures that are well developed, inexpensive, and in wide-spread use. The introduction of this new lining technique offers an opportunity to the metal industry for marketing a wide range of metal-reinforced constructions in industrial, agricultural, and domestic services. The thin-walled, metal-plastic combination is also an economic way to expand the working range of a line of plastic pipe when specifications stipulate increased service limits.

Equipment used by Du Pont for the initial experiments consisted of a standard wire or tube drawing rig. The plastic liner was slipped inside the metal tube, which was pinched at the end so that it could be freely threaded through the die. After insertion, the end was attached to the pull-chain and the wind-up mechanism put into motion. On winding in the chain, the metal tube was drawn down smoothly onto the liner. This gave a perfect metal-plastic assembly provided that the die, liner, and tube sizes had been suitably estimated.

The series of experiments suggested drawing as an attractive method for lining metal tubes with plastic. The only modification of the normal tube drawing operation necessary was the insertion of the plastic liner. It was found to be suitable even for lining tubes as small as hypodermic needles. The principal limitation inherent in the drawing operation appeared to be strain hardening. If appreciable strain hardening cannot be tolerated in any particular lining application, then sizing the liner and tube for minimum area reduction coincident with tight fit will help. Conversely, a high degree of strain hardening, if desired, could be achieved by a large reduction of area. The largest possible area reduction is obtained when the stress in the tube reaches the yield stress of the metal. This condition depends on the die angle, the draw characteristics of the metal, and die-to-metal friction. In practice, reductions of 50-60% area are considered practical.

—The End



Sketch Courtesy: E. I. Du Pont De Nemours & Co., Inc.

Free-hand diagram of tube drawing onto a plastic liner.

Louis Frank Rahm

Dr. Irving Skeist

Henry M. Richardson

Judges Named for

"Achievement Awards" Competition

A three-man panel of judges for the competition on "Achievement Awards in Plastics Technology" has been selected. The judges will be Louis F. Rahm (chairman), Irving Skeist, and Henry M. Richardson.

Louis Frank Rahm was born in Newark, N. J., in 1899. He attended the University of Michigan, receiving a B.S. in Mechanical Engineering in 1921. After graduation, he was employed as a designer by DuPont Viscoloid Co. (Leominster, Mass.) in 1921, and by Picatinny Arsenal (Picatinny, N. J.) in 1922. From 1923-26, he was an instructor in engineering at the University of Illinois. He joined his present affiliation, Princeton University, in 1926, and in the period to 1945 was appointed successively Instructor, Assistant Professor, Associate Professor, and Professor of Mechanical Engineering. Since 1945, he has been Director of the Plastics Laboratory at Princeton University, in addition to serving as Professor of Mechanical Engineering. He is a member of S.P.E. and Sigma Xi. Professor Rahm is divorced, has two sons, Michael and Dick (22 and 19 years old, respectively), and makes his home in Princeton, N. J.

Dr. Irving Skeist is a chemical consultant, specializing in plastics. He received a B.S. in Chemistry from Worcester Polytechnic Institute, and an M.S. and Ph.D. in Polymer Chemistry from Polytechnic Institute of Brooklyn. He has been Research Chemist, Marketing Specialist, and Technical Director with Celanese Corp. of America, Gering Products, Inc., American Molding Powder & Chemical Corp., and Newark Paraffine & Parchment Paper Co. He is a Registered Patent Agent, and the author of the book, "Epoxy Resins," and numerous economic and technical studies and patents on plastics, plasticizers, adhesives, and polymerization. He is a member of A.C.S., S.P.E., S.P.I., the Association of Consulting Chemists & Chemical Engineers, and other organizations. At present, he is Vice President of Skeist & Schwarz Laboratories, Inc. (Newark, N. J.). Dr. & Mrs. Skeist have four children, and reside in Summit, N. J.

Henry M. Richardson graduated from the University of Colorado in 1925 with a B.S. in Electrical Engineering. He joined General Electric Co. immediately thereafter, and was with that company until 1943. From 1925-28, he was given advanced training and taught an Advanced Course in Engineering, and also did research work in electrical machinery and statistical methods of business analysis. From 1928-36, he was engineer in charge of development for plastic product applications. From 1936-43, he was Chief Engineer in charge of all engineering development and research work carried on in five G-E plants. Since 1943, he has been a principal in DeBell & Richardson, Inc. (Hazardville, Conn.), and a Consulting Engineer to the plastics industry. Henry Richardson is a member of S.P.E., A.S.M.E., and other organizations, received the Naval Ordnance Development Award in 1945, and co-authored the book, "Fundamentals of Plastics" (McGraw-Hill, 1946).

—The End

For Official Entry Blank, write to Executive Secretary, Achievement Awards in Plastics Technology, c/o PLASTICS TECHNOLOGY Magazine, 630 Third Avenue, New York 17, N. Y.

Presentation of the Awards for 1958-1959 will be made in a special meeting on Jan. 13, 1960 in conjunction with the SPE 16th ANTEC at the Conrad Hilton Hotel, Chicago, Ill. (ANTEC dates, Jan. 12-15).

Names in the News

Richard Hagemeier has been appointed sales representative in Colton Chemical Co.'s Chicago branch office. Formerly of McKesson & Robbins, Inc., he will represent Colton in the sales of resin.

Paul Winz, for the past ten years with plastics laboratories of Bayer, Krehfeld-Uerdingen, W. Germany, has been added to the laboratory staff of Mesa Plastics Co., Los Angeles.

Robert C. Springborn has been selected manager of research for Marbon Chemical Division, Borg-Warner. He will be located at the company's new plant in Washington, W. Va.

Gordon B. Lankton has been appointed sales and technical engineer for Stanley Chemical Co., East Berlin, Conn. He formerly served as a plastics technologist with Du Pont, developing new techniques and applications for injection molding.

James H. Worth has been elected vice president of Celanese Chemical Co. and **William P. Orr** vice president of Celanese Plastics Co., recently established divisions of Celanese Corp. of America. Mr. Worth had been assistant general manager of the firm's former chemical division, and Mr. Orr had been assistant general manager of the former plastics division.

OBITUARY

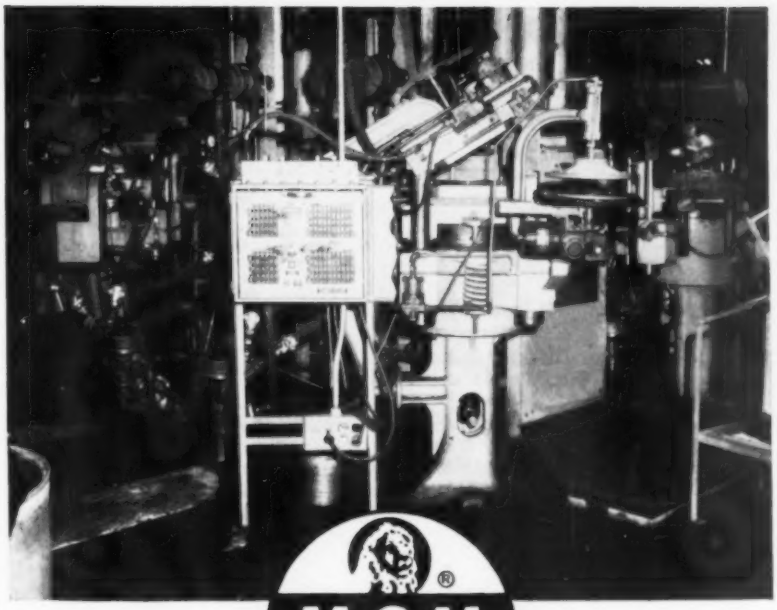
Frank W. Egan

Frank W. Egan, founder and chairman of the board of Frank W. Egan & Co., Somerville, N. J., died July 29 after suffering a stroke four days previously. He was 67 years old.

Mr. Egan and his sons, Edward F. and Lawrence W., formed the company in 1946. He had previously served as vice president of the John Waldron Corp. The firm manufactures extruders, rolls, and laminating equipment.

A native of Jersey City, Mr. Egan made his home in Brielle, N. J. He is survived by his wife, Louise A., his sons, and six grandchildren. The funeral was held in Spring Lake Heights, and interment was in St. Catherine's Cemetery, Sea Girt.

Mr. Egan was a well known authority on paper coating and laminating, and had many articles published on these subjects. He had been active in the industry for more than 38 years.



M-G-M RECORDS

M-G-M SAVES TIME

. . . and boosts production with

Taylor-Emmett ROBOTRON* Cycle Controller

In record curing, seconds saved mean dollars earned. The ROBOTRON Timer speeds up the operation because cycles can be changed so easily and quickly *from the face of the timer.* It is even possible to change curing procedures in the middle of the cycle if necessary . . . an important feature when curing procedures have to be continually adapted to the condition of the raw material. Exact repeatability of timing cycles is assured by this dependable controller.

M-G-M Records, Inc., Bloomfield, N. J., are very well satisfied with the uniformly high quality product coming off their ROBOTRON controlled presses, also the appreciable reduction in rejects.

Photograph above also shows Taylor-Emmett NEV-R-GRIND* Valves in use on steam, water and hydraulic lines to control opening and closing of the press as well as heating and cooling. NEV-R-GRIND construction means no warping, no fouling, no grinding, thanks to a new Teflon disc design that insures continued tight seating. Compact, simple design requires practically no maintenance.

• • •

For more information about Taylor-Emmett valves and timers, write Taylor-Emmett Controls, Inc., Akron, Ohio, or Taylor Instrument Companies, Rochester, New York.

*Trade-Mark

Taylor-Emmett Controls, Inc.

A SUBSIDIARY OF *Taylor Instrument Companies*

NEWS of the Industry

organizational changes

Glidden Co. has constructed a $600,000 synthetic resin reactor at its plant in Cleveland. This marks the beginning of a $2,250,000 resin expansion program. Three other units have been approved for construction, and will be installed in Chicago, San Francisco, and Toronto.

Brown Co., Boston, Mass., has added two lines of polyethylene pipe to its Bermico line. They include bituminized fibre pipe for drainage and conduit for direct burial electric wiring.

National Aniline Division, Allied Chemical Corp., has announced a 50¢ per pound reduction in the price of Nacconate 300, a basic isocyanate used in making solid urethane rubbers and elastomers. New price is $1.25. Nacconate 1300-50C, a solution of Nacconate 300, is reduced 14 cents to 86 cents per pound. This material is used primarily in coatings.

Robeco Chemicals, Inc., New York City, is offering clear transparent vinyl film, both extruded and calendered. The film is extruded abroad on equipment manufactured by **Modern Plastic Machinery Corp.,** and is available in 54-inch widths and thicknesses from ½-4 mils. The calendered film is offered in 54-inch widths and thicknesses from 1.2-20 mils.

U. S. Rubber Co. has added two new grades to its Fiberthin line of coated nylon fabrics. Formulations were developed at the company laboratories in Stoughton, Wis.

New Rochelle Coating Corp. has designed, erected, and installed one of the largest pressure-sensitive coating machines ever built. The unit is capable of handling a web of material more than five feet wide.

Globe Rubber Works, Inc., of Boston and Springfield, Mass., recently added mixing and metering equipment for the production of flexible urethane foam. A new entry into the urethane field, Globe has been engaged in the distribution of industrial rubber products for the past 70 years.

Reynolds Metals Co. has installed new equipment at its plant in Hurricane Creek, Ark., which will increase substantially its capacity for producing hydrated alumina with a particle size averaging less than one micron. Previously, production was on a pilot plant scale.

Barclite Corp. of America has added a custom line of reinforced plastic panels to its "Designer Group" line. Three patterns are included.

American Viscose Corp.'s research & development division has undergone an organizational realignment, thus creating a polyolefin department. Headed by John A. Howsmon, this department absorbs the duties of the old basic research department plus work on polypropylene fiber development.

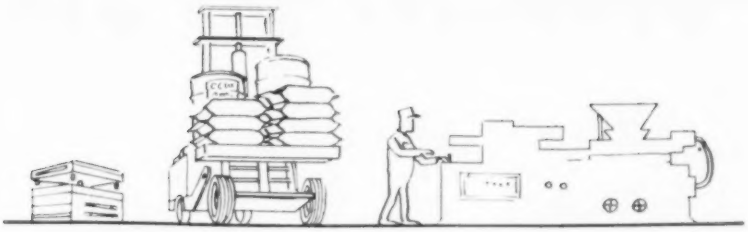
Armstrong Cork Co. has installed an automatic tumbling and washing system at its packaging materials plant in Lancaster, Pa. This system should provide dust-free molded plastic closures.

Toyad Corp., Latrobe, Pa., is now producing products from Chemfoam E, a low density polyethylene foam. The product is unicellular, and should be of interest in buoyant and automotive gasket applications.

Goodyear Tire & Rubber Co.'s flooring department is now producing its all-vinyl Ever-gleam counter top line in 27-inch wide rolls. Formerly, production was limited to widths of 36 and 45 inches.

new plants, labs & additions

Plastic Materials & Polymers, Inc., Hicksville, N. Y., has announced a plan for opening regional plants in various parts of the country, beginning with a 26,500 square foot unit at Slatersville, R. I. Scheduled for opening this month, the plant will be operated as a separate subsidiary under the corporate name of **Eastern Plastic Materials, Inc.**



Sohio Chemical Co. has broken ground for a multi-million dollar petrochemical plant for the manufacture of acrylonitrile, based on a new process developed in the Sohio Research Center in Cleveland. Completion of the unit is scheduled for early 1960.

Taylor Fibre Co. has moved its Chicago sales office from 2414 West Lawrence Ave. to 5320 West Lawrence Ave. The TWX number, CG 2712, remains the same. The new area, being less congested, means easier access and better parking facilities.

Tennessee Eastman Co. has begun construction of a multi-million dollar addition to its Kodel polyester fiber facilities at Kingsport, Tenn. Scheduled for completion by mid-1960, the unit will boost the firm's production of the fiber in excess of 20 million pounds.

Marco Development Co., Inc., has moved to new quarters at New Castle Ave. and Rogers Road, Wilmington, Del. Company president, John Marco, stated " . . . that large plant and engineering facilities are required to meet the increasing demand for the firm's commercial pumps, mixers, reactors, and homogenizers."

Rogers Corp., Rogers, Conn., has opened the first facility on the east coast for the manufacture of diallyl phthalate molding compounds. The unit is located in Manchester, Conn. Rogers first produced the resins in pilot-plant quantities late last year.

Reichhold Chemicals, Inc., has opened its $500,000 formaldehyde plant in Kansas City, Kan. Capacity of the firm's seventh domestic formaldehyde facility is 30 million pounds per year.

Plastic Molders Supply Co., Fanwood, N. J., has opened a new plant and warehouse in Norwalk, O. Designed to increase the company's capacity from 50- to 100-million pounds annually, the plant assures overnight deliveries of dry colorants to Midwest customers.

changes in corporate name

Lynch-Robbins Corp. is the new official name for **Robbins Plastic Machinery Corp.** The change was made to bring the Lynch name more prominently to the attention of plastics processors, since packaging operations are being more closely identified with plastics.

Bill DeWitt Division, Shoe Form Co. has recently changed its name to **DeWitt Plastics.** The division was the first to make plastic lures, spoons, spinners, and plastic tackle boxes.

agents, distributors & agreements

Frank W. Egan & Co. has licensed **Ankerwerk Gebr. Goller** of Nuernberg, W. Germany to import an injection molding machine with screw-type plasticizers into the United States. The plasticizer is an invention of Egan vice president W. H. Willert, a member of PLASTICS TECHNOLOGY'S Editorial Advisory Board.

Mol-Rez Division, American Petrochemical Corp., has appointed **Hamlin & Morrison Co.** as sales representatives for its Pleogen polyester resins in Eastern Pennsylvania, New Jersey, Maryland, Delaware, and Washington, D. C. H & M are located at 216 South Second St., Philadelphia, Pa.

J. M. Huber Corp. has appointed two distributors for its new series of Huber kaolin clay extenders and Zeolex silicate pigments. **C. Withington Co., Inc.,** Long Island City, N. Y., will represent them in Metropolitan New York and Florida; **John K. Bice Co.** of 400 Seaton St., Los Angeles, will cover Southern California, Arizona, New Mexico, Utah, Colorado, and Wyoming.

Lunn Laminates, Inc., has terminated its franchise with **Bellingham Shipyards Co.,** for the manufacture and distribution of Bell Boy boats. The reason given was the backlog of Navy and other military orders, which have been the backbone of growth in the reinforced plastics industry.

M&T Products for plastics

Thermolite® ORGANOTIN Stabilizers

Used alone for unmatched performance in optical clears, or synergistically to greatly boost the stabilization characteristics of less effective stabilizers.

Thermolite Organotins are the first choice for premium crystal clarity in PVC – and are often the successful last resort when other stabilizers fail under difficult processing conditions.

FOR ULTRA-HIGH TEMPERATURE STABILITY in the processing of rigids and semi-rigids

Thermolite 31–Processing at 350 F and above is practical with this stabilizer. Unexcelled for clear or pigmented rigids.

Thermolite 20–Lubrication is built into the molecule of this organotin. For use alone or with Thermolite 31, as lubrication requirements dictate.

FOR VERY-HIGH TEMPERATURE STABILITY

Thermolite 13–Outstanding light stability and excellent heat stability are contributed by an organotin-dienophilic combination in the molecular structure. Particularly suitable for plastisols, rigids, semi-rigids and blending with other Thermolites.

Thermolite 17–Combines the heat stability of the dienophilic Thermolite 13 with the high-lubrication of Thermolite 12. An ideal stabilizer for calendering and extrusions.

Thermolite 12–Outstanding light stabilization and excellent lubrication augment good heat stability. These properties plus ready solubility in plasticizers make it unusually useful for plastisols and organosols.

Thermolite 45–Low-cost organotin for calendering and extrusion. Eliminates clouding in garden hose and other clear PVC's exposed to water.

FOR ALL-PURPOSE ORGANOTIN STABILIZATION

Thermolite 25–Widely used in plastisols because of its excellent heat and light stability and is especially valuable in slush molding where it gives no plate-out problems.

Thermolite 26–A self-lubricating stabilizer with good heat and light stability, especially recommended for calendering vinyl copolymers for decorative sheeting, etc.

Thermolite® LIQUID Ba-Cd Stabilizer

A unique, new concept in Ba-Cd stabilizers for low-cost processing clarity and outstanding light stabilization.

Thermolite 112–A completely aromatic-based, low-volatility stabilizer giving crystal clarity and excellent light stability. Soluble in all plasticizers this Ba-Cd stabilizer overcomes plate-out in calendering and extrusions.

Thermolite® AUXILIARY Stabilizers

...Designed to augment the compounding and performance characteristics of the primary stabilizers.

Thermolite 166–A liquid-zinc stabilizer used in conjunction with Ba-Cd types to improve initial color, reduce plastisol viscosity and overcome sulfur staining.

Thermolite 180–An antioxidant-stabilizer of purely organic composition for use with all metal stabilizers to improve light stability, help overcome plate-out, and prevent yellowing during processing.

CATALYSTS Urethane Foam

A complete line of catalysts used in one-shot urethane foam systems.

Catalyst T-12 (Dibutyltin dilaurate)
Catalyst T-8 (Dibutyltin di-2-ethyl hexoate)
Stannous Octoate
Stannous Oleate

M&T FLAME RETARDERS

...For incorporation in PVC and other chlorine-containing films and coatings to provide "non-inflammable" characteristics.

M&T Thermoguard* H–High tinctorial strength antimony oxide for whites and pastels where it contributes useful white-tinting strength.

M&T Thermoguard* L–Low tinctorial strength antimony oxide a minimum opacity antimony oxide particularly suitable for deeper colors.

M&T Flame Retarder–An antimony-based flame retarder that has one-fifth the tinting strength of antimony oxide and designed for semi-transparent plastics or those containing high-cost pigments and toners.

**Trade Mark*

For information on any of these products write to:

M&T Chemicals

METAL & THERMIT Corporation, Rahway, N. J.

Sn Sb P inorganics and
Si Ti Zr organometallics

New Materials

Write item numbers on Readers' Service Card (p. 89) to obtain more information.

Three Organic Acids

Union Carbide Chemicals Co. is producing n-valeric, *iso*-Pentanoic acid (mixed isomers) and 2-methylpentanoic acids commercially. n-Valeric (valerianic acid and n-pentanoic acid) is a straight-chain, five-carbon, aliphatic, monobasic acid possessing the characteristic pungent odor and taste of medium molecular weight monocarboxylic acids. *iso*-Pentanoic acid (mixed isomers) consists of five-carbon, aliphatic, monobasic n-valeric and methyl butyric acids. 2-Methylpentanoic acid is a branched-chain, *alpha*-substituted, six-carbon, aliphatic, monobasic acid.

Esters of each of these acids may be used as plasticizers in PVC resins, and metallic salts (especially barium) are possible stabilizers for these resins. They also may be useful in isophthalic-type alkyds for automotive and appliance coatings where high gloss retention and resistance to dirt pick-up is needed.

Direct comparison tables of performance characteristics are available. Typical properties are:

	n-Valeric	iso-Pentanoic	2-Methylpentanoic
Molecular weight	102.14	102.14	116.17
Specific gravity	0.9401	0.9388	0.9242
Boiling pt., °C., 760 mm.	186.2	183.2	196.4
50 mm.	113.0	111.0	122.0
10 mm.	82.0	80.0	92.0
Vapor pressure, 20° C., mm.	0.08	0.14	0.02
Freezing point, °C.	−34.8	−44.0	−85.0
Solubility, % by wt., in water, 20° C.	2.4	3.24	1.3
water in, 20° C.	13.0	10.4	2.9
Viscosity, absolute, 20° C., cps.	X	2.2	2.9
Refractive index, n_D^{20}	1.4088	1.4076	1.4135
Flash point, open cup, °F.	205	205	225

Readers' Service Item 1

Fluorescent Pigments

Lawter Chemicals, Inc., has announced a line of Hi-Viz fluorescent pigments available in pink, red-orange, green, orange, red, lemon yellow, cerise, and gold yellow. These finely powdered pigments fluoresce under ultra-violet or daylight illumination, but have no afterglow. They are recommended for use as the coloring agent in polyethylene, polystyrene, and vinyl plastisols, in plastic sheeting, and in silk screen printing.

Athough the pigments are insoluble in water, aliphatic hydrocarbons, and most aromatic hydrocarbons, their solubility in esters, ketones, and ethers prohibits some applications. They will resist dilute acids and alkalis, but are decomposed by strong mineral acids and alkalis. Indoors they will last indefinitely. Their weatherability outdoors depends on the vehicle color, time of the year, thickness of the film, and local climatic conditions.

Hi-Viz pigments have been used in items such as toys and industrial equipment to introduce high visibility and safety characteristics. They may be mixed with non-fluorescent pigments to brighten the tonal qualities of regular colors. Typical properties are:

Softening point, °C.	145-155
Specific gravity	1.36
Average particle size, microns	3.2-3.5
Decomposition point, °C.	180-200
Bulking value, gal./lb.	0.0883
lbs./solid gal.	11.33
Oil absorption, lbs. alkali refined linseed oil/100 lbs. pigment	56
Critical pigment volume conc., (linseed oil), %	55.1
Refractive index	1.61-1.63

Readers' Service Item 2

Modified Acrylic Copolymer

A properly-compounded floor polish based on Rhoplex B-78, Rohm & Haas Co.'s modified acrylic copolymer emulsion, forms glossy, continuous films at low temperatures. The polymer is hard, and is claimed to have excellent initial color, good color retention, excellent water resistance, and good removability and gloss. The milky-white liquid emulsion contains 36% solids with a pH between 8.7 and 9. Weight per gallon is 8.7 pounds.

On a non-porous substrate, the typical film-forming temperature of 36% Rhoplex B-78 is 22° C. The clear, colorless films, with a Tukon hardness of 12.0 KHN, will neither discolor with age nor oxidize to an insoluble product. In addition, because of an inherent balance between water resistance and removability in the polymer, ease of removability can be very conveniently adjusted by the addition of alkali-soluble resin.

Readers' Service Item 3

Compounded Thermoplastics

A pearl polypropylene and dull finish poly-blend for blow-molded doll bodies have been developed by Plastic Materials & Polymers, Inc. The non-toxic pearl polypropylene is suggested for application in closures, containers, cosmetic cases, brushes, bag, buttons, and jewelry. The poly-blend, which is designed to simulate a baby's skin, will be compounded to satisfy different specifications in soft or semi-rigid polyethylene combined with color and additives.

The company also produces other special-effect plastics such as pearlon, phosphorescents, metallics, and tinsels.

Readers' Service Item 4

RONA™

SYNTHETIC

PEARL PIGMENTS

FOR COMPOUNDING INTO

- POLYETHYLENE
- POLYSTYRENE
- VINYL
- ACETATE
- NITRATE
- ACRYLICS
- CASEIN
- POLYESTERS
- PHENOLICS (CAST)
- ACRYLICS (CAST)
- POLYPROPYLENE
- and other resins

COATING ALL SURFACES

Rona Pearl Pigments are heat and light stable, non-reactive non-corrosive, and impart high pearly luster, exceptional depth and brilliance at very low cost.

RONA LABORATORIES, INC.

East 21st and East 22nd St., Bayonne 7, N.J.

Manufacturers of Pearl Essence exclusively

Plants: Maine New Jersey Canada

VINYL UPHOLSTERY PRODUCERS
who use
Plastolein 9720 Polymeric
have two unbeatable allies:

TIME—the final judge of quality. Plastolein 9720 Polymeric has excellent permanence, thanks to low volatility, low migration, and outstanding resistance to "wipe-off," heat and ultraviolet light. These qualities are a comfort to our customers because they *know* their products will far outlast competitive products using monomeric plasticizers.

COST—the powerful competitive edge. Plastolein 9720 is the *lowest cost* polymeric plasticizer on the market today. In addition, its relatively low viscosity makes processing easier and permits the economies of bulk shipping, storage and handling.

Why not get both these advantages on *your* side? Write Dept. Q-10 for booklet–"Plastolein Plasticizers"

PLASTOLEIN® plasticizers
Emery

Organic Chemical Sales Department
Emery Industries, Inc., Carew Tower, Cincinnati 2, Ohio
Vopcolene Division, Los Angeles
Emery Industries (Canada), London, Ontario
Export Department, Cincinnati

Machinable Ceramoplastic

Supramica 620, a ceramoplastic reported to have temperature resistance 60% higher than other ceramoplastics, is available from Mycalex Corp. of America. Designed to replace insulating materials such as alumina and steatite, Supramica 620 may be used in radio transmitter and receiver insulation, switchboard panels, high frequency machines and fixtures, heating devices, welding jigs and fixtures, relay contact supports, brush holders, and in X-ray and nuclear devices.

Supramica 620 has a fine, uniform texture, and will maintain dimensional stability under adverse conditions of thermal cycling, humidity, and moisture. Typical properties are:

Electrical:	
Dissipation factor, 1 megacycle	0.0015
Dielectric constant, 1 megacycle	7.2
Loss factor, 1 megacycle	0.011
Dielectric strength, volts/mil, ⅛-inch thickness	250
Arc resistance, seconds	300
Thermal:	
Maximum operating temperature, °F.	1550
Thermal expansion coef./°C. x 10^{-5}, 0-300° C.	11.6
T_o value, temp./10^6 ohm cm. °C.	550
Thermal conductivity, cal./cm.²/sec./°C./cm. at 100° C.	0.0012
Mechanical:	
Tensile strength, psi.	5,000
Compressive strength, psi.	35,000
Flexural strength, psi.	10,000
Modulus of elasticity x 10^6, psi. (static loading)	12.5
Impact strength, Charpy, ft./lb./sq. in.	0.5
Specific gravity	3.2
Rockwell "M" hardness	110

Readers' Service Item 5

Phthalocyanine Pigment

Heliogen Viridine Y is General Aniline's phthalocyanine pigment which has been physically conditioned to give a yellower shade than conventional Heliogen Green types.

Of the several forms in which the viridine pigment is available, the toner (Y Powder), lakes (YL, YCL, and YCA Powders), and plasticizer dispersion (Y in DOP) are most adaptable for use in plastics. Y Powder is 100% finely-ground, free-flowing pigment. YL and YCL, compounded especially for use in vinyl floor tile, contain 50% and 25% calcium carbonate, respectively. YCA also contains 25% calcium carbonate, but is more finely ground than YCL. It is used in vinyl, styrene, and polyethylene resins. Y in DOP is a dispersion of the toner in dioctyl phthalate for use in flexible vinyls.

The pure pigment did not bleed when treated with alcohol, xylene, lacquer, MEK, mineral spirits, or diethylene glycol. It showed excellent stability in solutions of 5% hydrochloric acid, 2% sodium hydroxide, and 2% acetic acid.

Heliogen Viridine Y in DOP weighs 10 pounds per gallon. The solution consists of 40% pigment to 60% DOP. Properties of the powdered pigment are:

	Y	YL	YCA
Specific gravity	2.4	2.2	2.6
Wt./gal.	19.99	18.33	21.66
Bulking value, gal./lb.	.05003	.05456	.04617
Oil absorption	30	15	40
Suggested grinding ratio (in litho varnish), %	35	70	54

Heliogen Viridine Y, according to the Fade-O-Meter, has a minimum life of 200 hours in vinyl, 260 in polyethylene, and 100 in polystyrene. There was no evidence of crocking in vinyl, and no migration after two weeks at room temperature. The pigment is suitable for printing inks.

Readers' Service Item 6

"...when considering plasticizers, we first stress performance."

Ed Hamway, Technical Director of the Textileather Division of The General Tire and Rubber Company says:

TOLEX®

"Our customers are looking for performance . . . not only for today but for the life of their product. We believe that Textileather fabrics enjoy a good reputation among our customers because of their high quality and consistent performance.

"So when considering plasticizers, we first stress performance. We are always striving for a little quality advantage to give us a slight safety factor because we have found that this eliminates all complaints, which are not only costly but are harmful to our reputation.

"When considering the cost factor, we know we can save money by using versatile plasticizers that can be used in a large number of formulations. And, in the processing area, freedom from trouble and a minimum of scrap from formulations are also cost-reducing factors.

"Thus, the true cost of a high quality plasticizer is not always the initial cost, but one that has been reduced by all these cost-cutting factors *plus* the assurance of a consistently performing vinyl product."

Where the accent's on quality
there's a preference for ***Plastolein® Plasticizers***

Emery

Organic Chemical Sales Department
EMERY INDUSTRIES, INC., CAREW TOWER, CINCINNATI 2, O.
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MOLD DESIGNERS

SAVE MORE ON MOLD COSTS With Over 6,000 D-M-E Standard Mold Bases to Choose From

Whether it's a one-cavity "test" mold or a 60-cavity high production run, chances are D-M-E has the right size Standard Mold Base to fit the job and the molding machine.

D-M-E's 32 standard sizes, up to 23¾" x 35½", with 100 standard cavity plate combinations for each size, give you the largest selection of carbon or alloy steel standards available from any single source.

Save on Design and Moldmaking Time, Replacement Parts and Delivery

Design time is reduced by using D-M-E's full-scale Master Layouts and Catalog of specifications and prices. Moldmaking time is reduced because all D-M-E plates are precision ground flat-and-square, ready for cavity layout and machining. Exclusive interchangeability gives you the added saving of immediate replacement of any component part. And D-M-E's seven branch offices and warehouses are always fully stocked with Standard Mold Bases and components to meet your delivery requirements.

Cut Costs on Your Next Program

Start saving on your next moldmaking program, no matter how large or small. Take advantage of D-M-E Quality, Service and Economy.

Faster deliveries from complete stocks

Over 1,000 D-M-E Standard Mold Bases always IN STOCK at local D-M-E Branches for IMMEDIATE DELIVERY.

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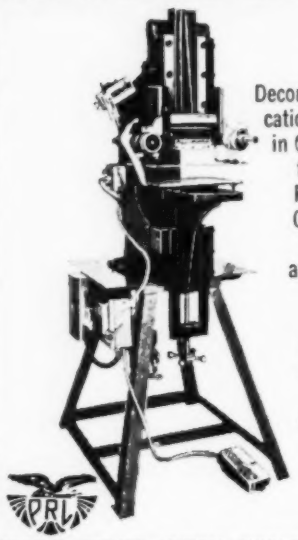
PLASTIC MARKING



For Trademarking, Decorating, and Identification. Peerless Roll Leaf in Genuine Gold, Imitation Gold and Silver, Pigment and Metallic Colors. Complete line of stamping presses and attachments, dies and type, heating plates, cutters, etc. Over 35 years of roll leaf marking experience available to our customers. Write for free folder.

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NEED HEAT?

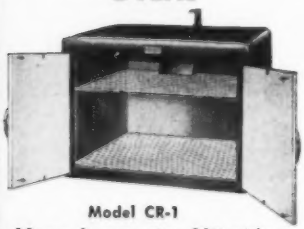
One of our 85 Standard Industrial Ovens will meet your needs. BENCH • CABINET • WALK-IN TYPES.

For preparation of materials and chemicals for production.

On the production line for intermediate heating.

For baking-on finishes or drying.

GRIEVE-HENDRY OVENS



Model CR-1

10 cu. ft. capacity—30" wide x 25" deep x 24" high. Removable shelves and drip pan. Forced air circulation. Adjustable temperature control to 225° F. **$121.50** f.o.b. Chicago

Quick quotations, prompt delivery, reasonable prices on Ovens built to your requirements.

Write for literature

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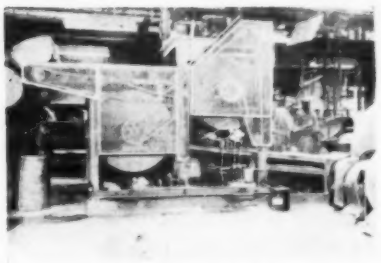
New Equipment

Write item numbers on Readers' Service Card (p. 89) to obtain more information.



Mayer cooling unit.

Tile Mottle Cooling Unit

Mayer Refrigeration Engineers, Inc., is manufacturing an asphalt-, rubber-, or vinyl-tile mottle cooling unit. Designed to handle 10,000 pounds of ⅛-inch thick and 36-inch wide mottle per hour, the operating speed is up to 40 feet per minute. Dimensions of the unit, in inches, are: length, 107; width, 64; and height, 95. The input temperature is 250° F., output, 75° F.; cooling water regulated at 40-45° F.

The unit employs "spray-blast" rolls and has an automatic edge control to maintain a uniform position of cooling roll belts. The conveyor is regulated with a variable speed that synchronizes automatically with the operating speed of the mill or calendar.

Readers' Service Item 21

Automatic Blow Molding Unit

The Model 1246 automatic blow molding machine was introduced this spring by Moslo Machinery Co. A self-contained unit, it requires no extruder or external attachments and can be operated by one skilled set-up operator.

The hydraulic system is manifold construction, utilizing Vickers equipment. It features a separate, console-type electrical control cabinet with Allen-Bradley relays, Eagle timers, and West Gardsman temperature controllers.

Following is a list of specifications:

Injection capacity per shot, ounces	4-6
Cycles/hr., dry run	690
Rate of injection, with & without booster, CIPS	9.36-2.62
Injection ram diameter, in.	2
Ram stroke, in.	8
Max. pressure on material, psi	20,000
Plasticizing capacity, lbs./hr.	70
Mold size, top half, in.	8 x 10
Thickness, in.	5
Bottom half, in.	8 x 23½
Thickness, in.	5
Mold opening, in.	5
Mold locking force, tons	90
Mold shifting stroke, in.	13½
Max. mold casting area, sq. in.	40
Hopper capacity, lbs.	75
Injection cylinder heaters, watts	7,000
Nozzle heater, watts	300
Cylinder operating temperature, °F	150-650
Heater voltage	230/3/60
Control circuit voltage	115/1/60
Motor, hp.	15
Motor speed, rpm.	1,200
Max. operating pressure, hydraulic system, psi	1,250
Oil tank capacity, gals.	77
Over-all dimensions, in.	90 x 46 x 74
Weight, lbs.	8,000

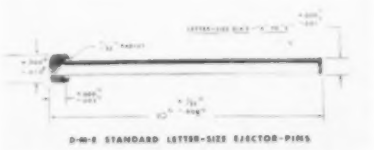
Readers' Service Item 22

Letter-Size Ejector Pins

Detroit Mold Engineering Co. recently introduced letter-size diameter ejector pins in standard 10-inch lengths. They combine with the regular fractional and 0.005-inch oversize pins to provide the most complete range of sizes available from a single source.

The pins are heat-treated die steel, ground, nitrided, and honed to a very smooth surface. The tough cores provide longer mold life, and the 70-80 Rc surface hardness reduces friction and cavity wear. Pin heads are solid, and annealed for added strength.

With the new additions, pins can be supplied with diameters in graduated steps from 0.0625-0.75 inch. On special orders D-M-E will produce stepped-diameter pins. Pre-nitrided blanks can be furnished if machine-tapered or contoured ends are required.



D-M-E Letter-Size diameter ejector pins.

Readers' Service Item 23

Three Hydraulic Presses

Three standard-size, self-contained hydraulic presses for laminating, embossing, or bonding are currently available from Lake Erie Machinery Corp. Known as the Acraplates, the presses are offered in seven tonnage capacities from 180 to 400 tons and platens from 24 by 20 inches to 36 by 28 inches.

All models are provided with calibrated pressure controls and can be equipped with either hand lever or automatic push-button operating controls. Seven inch daylight and stroke are standard, but can be varied to specification. Either electrically-heated or steam-heated platens can be obtained.

Lake Erie Acraplate press.

Specifications for four models of the S-12A7 press are as follows:

	Model 18	Model 27	Model 32	Custom 32
Capacity, tons.	180	270	320	320
Ram diameter, in.	20	24	26	26
Working height, in.	37	37	37	42
Over-all height, in.	58	64	66	74
Floor space required, in.	48 x 51	50 x 60	61 x 68	61 x 94
Weight, lbs.	8,200	13,650	16,500	21,330
Motor, hp.	3	5	5	5

Readers' Service Item 24

Filled-Steel Gasketing

Gasketing manufactured from spirally-wound strips of 18-8 vee-formed stainless steel with an inlay of filler material at each turn has been introduced by Sterling Packing & Gasket Co., Inc. Called Spiro-flex, it comes in two types: GR and WL.

Type GR consists of a standard spiral-wound ring inserted in the solid metal guide or reinforcing ring. The ring serves as a centering device for rapid and accurate location of the gasket on the flange, prevents lateral expansion of the gasket when compressed, and acts as a compression gage eliminating excessive strain on the flange stud. This assures a correct, positive seal when the gasket is compressed under bolt loading, to the thickness of the reinforcing or guide ring.

Type WL gaskets are supplied with wing-shaped location guides of the same formation and metal as the gasket itself. Inherent resilience automatically compensates for variation in pipe line stresses and for normal bolt relaxation. The guides retain the gasket in the flange in position while the flanges are being mated.

Readers' Service Item 25

HERCULES

Oxychemical

Hi-lites

SPOTLIGHT on Hercules Antioxidants

Now there is a Hercules antioxidant available for practically every requirement of the plastics industry. From Dalpac 4, technical grade, to Dalpac Food grade for use in films, coatings and molded containers, there is probably a Hercules product to meet your most stringent requirements.

Hercules today is the only completely integrated producer of di-tert-butyl-p-cresol and as such represents a reliable source of a consistently high quality product. If antioxidants are an important part of your operation why not let us tell you more about how Hercules can serve you.

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ACETONE · ALPHA-METHYLSTYRENE
ANTIOXIDANTS (DALPAC®) · CUMENE HYDROPEROXIDE (CHP)*
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HERCULES POWDER COMPANY
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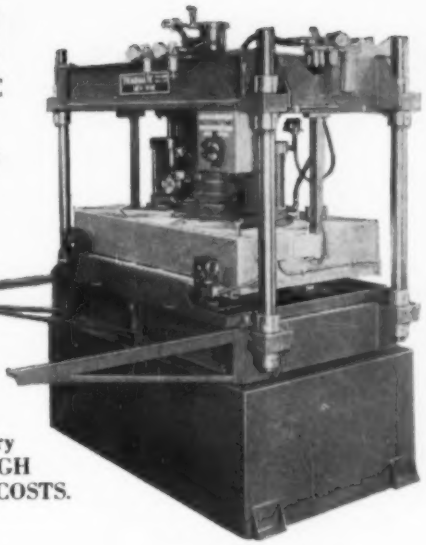
TRONOMATIC

HEAT-ASSIST, AIR HYDRAULIC

DIE-CUTTING PRESS

NEW!

TRONOMATIC CREATES A NEW APPROACH TO TRIMMING



A new concept in die cutting, permitting nearly unlimited cutting lengths by use of controlled heat, combined with HIGH force at speeds comparable to mechanically operated presses. Accommodates both sheet plastic and complete multiple blister or skin package cards. LOW DIE COSTS . . . utilizes ordinary steel rule dies. HIGH QUALITY PRODUCTION . . . HIGH SAFETY OF OPERATION . . . LOW MAINTENANCE COSTS.

Available in 2 standard sizes (cutting area: 24"x36" or 30"x50"), or custom-engineered to meet your requirements.

PACKAGING FOR PROFIT

with the new TRONOMATIC blister sealers—ranging from smaller units to fully automated turntable machines —point the way to expanded sales volume with modern blister packaging.

TRONOMATIC Can Supply All Your Cutting Die Needs

Wire or Phone Collect For Complete Information

TRONOMATIC MACHINE MANUFACTURING CORP.

1881 PARK AVENUE, NEW YORK 35, N. Y. • SAcramento 2-4611

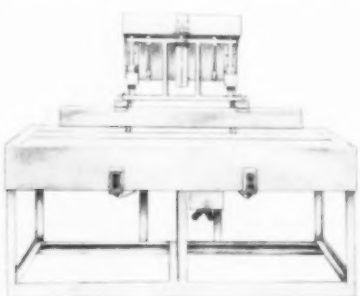
New Equipment (Cont'd.)

Electronic Heat Sealing Unit

An electronic heat sealer called the Post-Guided Press, Model PG-58, is available from Sealomatic Electronics Corp. Designed for producing items requiring long seals such as raincoats, mattresses, and tarpaulins, the unit has a levelling and adjusting mechanism which maintains uniform pressure on a table which can extend up to 96 inches long. It is marketed with generators up to 25 kw.

Bed size is eight by 60 inches, and is made from precision ground steel. Other sizes can be obtained to specification. Standard stroke is seven inches less height of die, and throat clearance is six inches from the center of the die, and throat of the press. Pneumatic controls include a vertical travel stroke control, an air pressure regulator, adjustable speed controls, and die-levelling balancing screws. The electric controls include dual pushbutton safety controls, which activate either of two emergency stop-buttons.

The unit can be obtained with heavy-duty steel C-frame or guillotine type, with two guide posts (four optional). The press itself is mounted on a welded steel frame base.



Model PG-58 electronic heat sealer.

Readers' Service Item 26

Plastograph-Vacuum Mixer

C. W. Brabender's Plastograph, which we described in an earlier issue, has been adapted to provide an inexpensive vacuum mixer. Intended originally as an instrument for measuring plasticity or consistency of highly viscous materials, it is now fitted with a vacuum chamber. The standard model can measure plasticity of all types of polymers having molecular weights up to the order of 1×10^6 to 3×10^6.

For solid propellants and higher polymers, the firm has a heavy-duty model which measures the flow properties up to 625° F. The new Chemical Industries Plastograph has a ½-hp. dynamometer which gives double the power of older models.

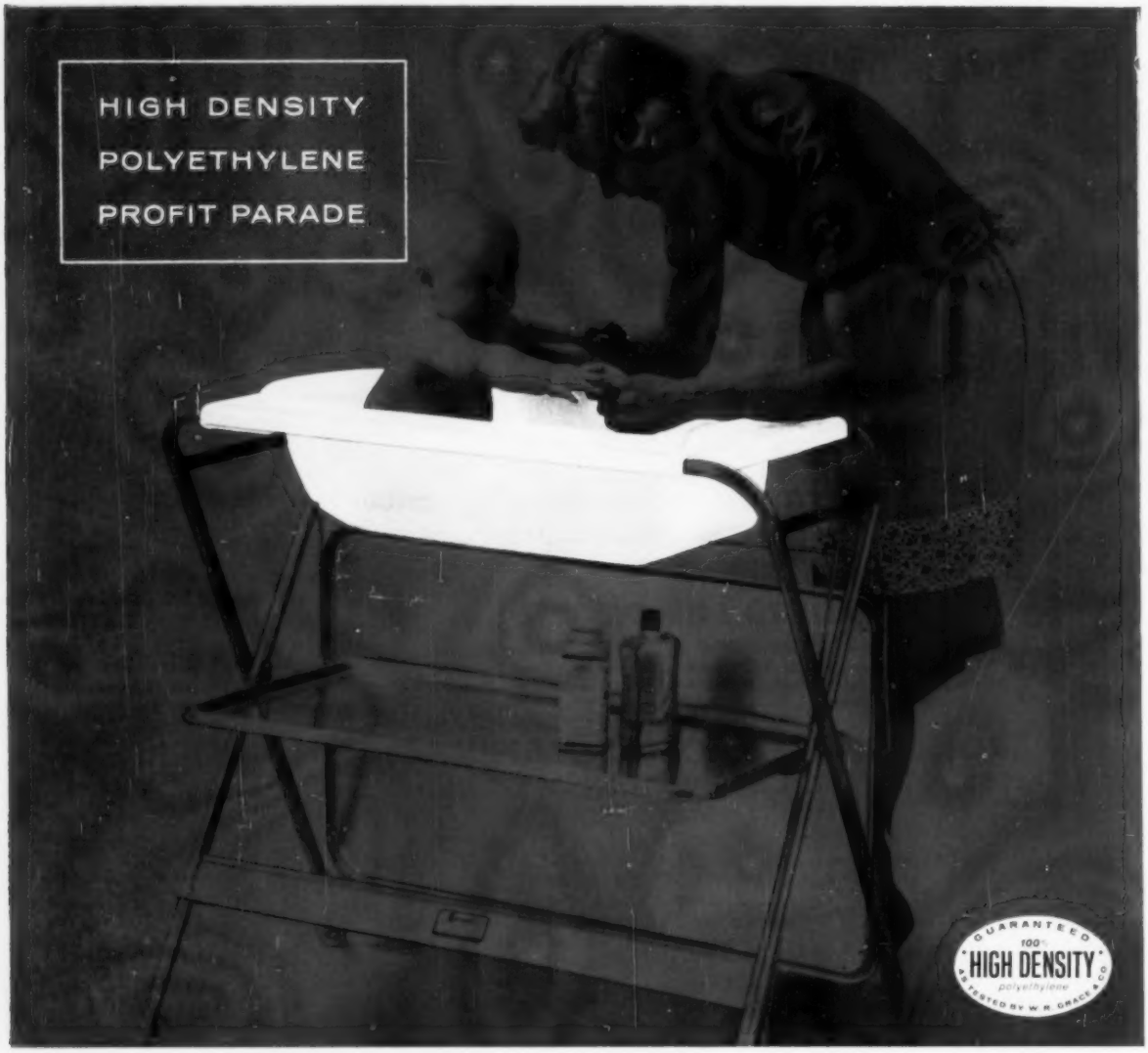
Brabender Plastograph.

Readers' Service Item 27

Six- & 8-Ton Bench Presses

Hannifin Co. has added six- and eight-ton models to its FD Series high-speed, bench-type hydraulic press line. The series is now available in two- through 12-ton capacities, with four different frames, choice of single or dual hand levers, electric push buttons, with or without pressure reversal, and index table (automatic feed) operation.

The new units stand 55 inches above the bench surface and are mounted on a 19- by 38-inch base plate (bases for floor mountings are also available). Both have a 12- inch stroke, an eight-in reach from



Exclusive Selling Advantages Offered in Lifetime Tub

Products in many different fields are gaining an edge over competition by utilizing the benefits of Grex high density polyethylene. The "Lifetime Tub" by Baby Bathinette Corporation is an example that really holds water.

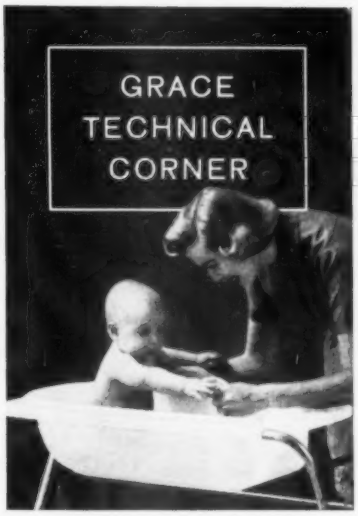
This well-known manufacturer chose Grex to make a tub that would outlast competitive models since this is a tough plastic that is virtually indestructible. They used its molding characteristics to obtain a soft, pleasant, easy-to-clean texture. They took advantage of its strength and rigidity to make the tub light in weight for greater ease of carrying.

This new Grace plastic offers a unique combination of properties to help you create unique selling advantages. It takes a beating without chipping, cracking or breaking. It can be molded in any color and decorated. It resists the elements and most corrosive chemicals. And it is the only thermoplastic that takes boiling or freezing without losing its shape or strength.

If you need an idea of how to gain an edge over competition by using high density polyethylene be sure to call in the experts. Grace has the production facilities, technical service and experience to help put your product in the Grex profit parade. We're easy to do business with.

Grex is the trademark for W. R. Grace & Co.'s Polyolefins.

W.R. GRACE & CO.
POLYMER CHEMICALS DIVISION
CLIFTON, NEW JERSEY



Grex answers design and molding problems on extra-large piece.

Don't let size limit your thinking when designing or molding with Grex high density polyethylene. The "Lifetime Tub" shown here is 30½" x 6½" x 19"—one of the largest pieces so far injection molded with this Grace plastic. Some of the technical thinking that went into this job may give you an idea of how to get the most from Grex.

Cost a design factor. Production of a piece as large as this tub invariably presents a cost problem. Taking advantage of the way Grex performs in thin wall sections, the designers were able to keep the amount of resin per tub to a minimum and permit economical cycle times. Use of thin walls, however, called for a design that would not only take care of the weight of baby and water but also provide for satisfactory suspension of the tub in its metal frame. Reverse curves solved both problems and minimized use of ribs and fillets to avoid heavy sections, sinks and depressions.

Mold surface. Depending on mold surface, Grex takes any finish ranging from high gloss to matte. In this case, it provided a smooth, pleasant texture—essential to protect baby and make cleaning easy—through the use of a highly polished chrome-plated mold.

Molding technique. Production of the tub involved a 3-pound shot of Grex, a large mold cavity and thin wall sections. Under these conditions, multigating was chosen over normal gating. With four gates the cavity was filled faster and strain reduced.

What are your problems? If you have a job in mind for high density polyethylene count on Grace for help. Now's the time to call, wire or write:

Technical Service Department,
Polymer Chemicals Division,
W. R. Grace & Co., Clifton, N. J.

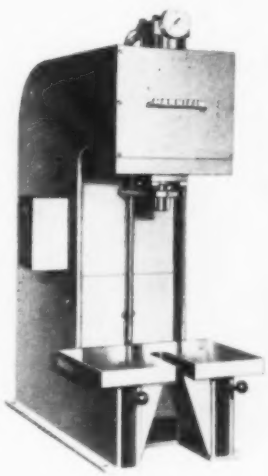
throat of frame to centerline of ram, and an 18-inch maximum distance between platens.

Specifications are listed as follows:

	Six-ton	Eight-ton
Bore, in.	3¼	3¼
Rod, in.	2	2
Pressure, max., psi	1,450	1,925
Advance speed, in./min.	300–840	300–840
Feed, in./min.	90–290	80–275
Return, in./min.	190–500	190–500
Motor, hp	3, 5, & 7½	5, 7½, & 10

Both have the following dimensions, in inches:

Stroke of ram	12
Ram centerline to frame	8
Table to ram, ram up	18
Table length	22
Table length	14½
Diameter of ram end	1¾
Diameter of ram counterbore	⅞
Depth of ram counterbore	¼
Width of table slot	2½
Projection of ram	1¾
Width between table supports	10



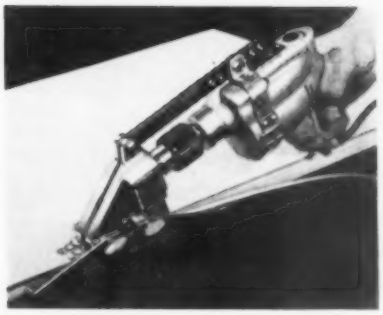
Hannifin bench-type press.

Readers' Service Item 28

Portable Plastic Shear

A portable, electric hand shear for plastics, including laminates, sheeting, mica, and the like, has been introduced in this country by Draco Division, L. E. Birbach Associates, Inc. The Draco Shear is currently being imported from West Germany, but will be produced locally some time this fall.

Lightweight and simple to operate, the shear cuts fast and accurately leaving no chips or fiber dust. It leaves a smooth mill-edge, thus eliminating the need for final sanding and finishing. No heating is required, and the shears will cut straight, curved, or circular patterns. It is easily attached to any ¼-inch electric drill.



Draco Type II plastic shear.

Readers' Service Item 29

Sheet Cutting Machine

United Shoe Machinery Corp.'s Hytronic cutting machine, combining hydraulic drive with electronic control, is reported to operate without jarring or vibration. Designed for die-cutting sheet material, this 1560-pound machine utilizes the swinging beam principle. The die is forced through the material onto a conductive cutting surface by an electronically-tripped beam, which is immediately recalled upon completion of the circuit.

The cutter, which operates with a 1-hp., 1725 rpm, AC, multiphase motor, is 36¼ inches wide, 40 inches deep, and 62½ inches high. The cutting surface may be 36 by 18 inches or 40 by 20 inches. Four sizes of beams are available, ranging from 13 by 28 inches to 24 by 31⅛ inches. The range of cutting stroke, with die heights from 5/16 to 2½ inches, is up to 2¼ inches.

United Hytronic cutting machine.

Readers' Service Item 30

Plastics Applications

Write item numbers on Readers' Service Card (p. 89) to obtain more information.

Fisher-Price Fire Truck.

Polyethylene Children's Toys

Marlex rigid polyethylene is being used in Fisher-Price Toys for greater realism and durability. In a fire truck, a pivoting extension ladder, rear-step platform and windshield are molded in detail which would have been difficult to reproduce in other materials. The Marlex parts will not crack or chip, and will not scratch furniture or other surfaces. Furthermore, the material is chemically inert and self-lubricating.

The plastic parts are molded by Trimold, Inc.

Readers' Service Item 41

Ivory-Colored Gavels

Gavels, made in sizes for men and women, are available from Lignum-Vitae Products Corp. Strong and impact-resistant, they can be supplied with silver or bronze bands for engraving.

The gavels are made from Eastman Tenite acetate, and are extruded by Rotuba Extruders, Inc. and Streamline Plastics Co.

Readers' Service Item 42

Lignum-Vitae acetate gavel.

Inner-lined Crash Helmets

The Toptex Safety Helmet, consisting of a molded fiberglass shell and an energy-absorbing expandable polystyrene lining, is reported to give maximum head protection and is comfortable and durable. Manufactured by Toptex, Inc., the helmets are sold by Federal Laboratories, Inc. The patented Dylite liner, a product of Zant & Associates, distributes and absorbs shock force and decelerates high velocity impact.

Dylite is produced by the plastics division of Koppers Company, Inc. The helmets are now being issued to motorcycle policemen in several cities.

Toptex Safety Helmet.

Readers' Service Item 43

Polystyrene Ice Bucket

Ice buckets molded of polystyrene foam and available from the Aeroplastics Corp., are reported to have superior insulating qualities. The Magikeeper will hold four trays of ice cubes, and may also be used for cookie storage or as a beverage case. It is light, weatherproof, and available in several bright colors.

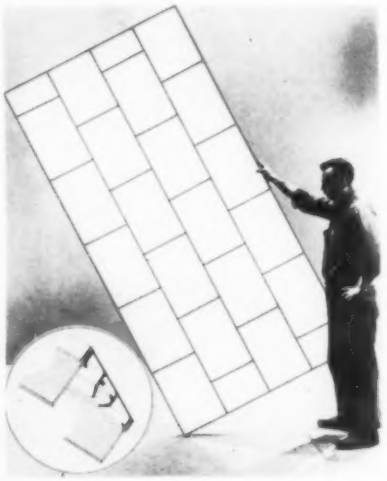
Aeroplastics' Magikeeper.

Readers' Service Item 44

Translucent Sandwich Panels

Panel Structures, Inc., is producing a fabricated plastic sandwich building panel assembled from fiberglass-reinforced polyester skins bonded to heavy extruded aluminum frames and internal grids. Weighing only 1½ pounds per square foot, Sanpan panels not only transmit diffused illumination, but insulate as well.

Three types, with identical insulating, structural, and acoustical properties, are available. Type A has a plastic skin flush with the perimeter section for application as curtain walls, exterior wall panels, interior partitions, roof panels, skylights, and canopies. Type B with a protective aluminum lip along the perimeter, may be



Sanpan aluminum and plastic building panel.

used as above and for room dividers, screens, and folding partitions. Type C has a protective lip and joint system for interlocking a series of units into interior partitions or exterior panel systems.

Standard panels come in 48-inch widths in 8-, 10-, 12-, or 20-foot heights. Custom sizes are available.

Reader's Service Item 44

Precision Oiler

The Blonde Oil Corp.'s precision oiler is a pocket-sized applicator and reservoir of transparent Eastman's Tenite butyrate. A thin tube with a press-on cap and pocket clip, the oiler has a small stainless steel spout like a syringe needle, and will inject lubricants directly into places on sporting gear, home and office appliances, and precision tools that ordinary spouts cannot reach.

Blonde precision oiler.

Readers' Service Item 45

Miniature Sleeve Insulators

Hyper-miniaturized electrical connectors for Convair's Atlas control systems met critical insulation tolerances by utilizing TFE sleeve insulators 3/16-inch in diameter and 7/16-inch long. The sleeves, machined to 0.001-inch tolerances, are fabricated from a special, high-density TFE on automatic screw equipment by Tri-Point Plastics Inc.,

This double-cup connector, produced by H. H. Buggie for the ICBM program, became a stock item for earthbound and airborne electronic systems, as well as for experimentation in advanced electronics

LOOKING FOR A

LOW COST, LOW TEMPERATURE PLASTICIZER?

HARFLEX® 500 IS YOUR BABY

SUMMER-SOFT IN WINTER- Harflex 500 keeps overshoes more flexible and durable despite cold.

PLIABILITY ASSURED - Harflex 500 eliminates the exasperations of handling a stiff hose — prolongs hose life.

HIGHLY RESISTANT TO WATER EXTRACTION AND LACQUER-VARNISH MIGRATION

To dolls, overshoes, garden hose and other vinyl and rubber products, Harflex 500 imparts dependable low temperature flexibility at amazingly low cost. Not only does it resist water extraction and migration better than higher priced low temperature plasticizers, but it also assures easy processing and high gloss. Where viscosity stability is essential, you have it with Harflex 500. No expensive viscosity depressant needed in plastisol and moulding operations. Prove the properties and economies of Harflex 500 yourself.

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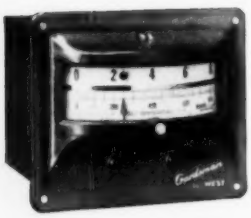

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Gardsman Model JP (shown) automatically adjusts On-time to Off-time to maintain any desired temperature within extremely close limits. Wide selection of Gardsman controllers provides for all control applications. All are tubeless, "solid-state" and proved in wide use. Phone your West consultant (see Yellow pages) or write Chicago office for Bulletin JP or for COM digest-catalog of line.

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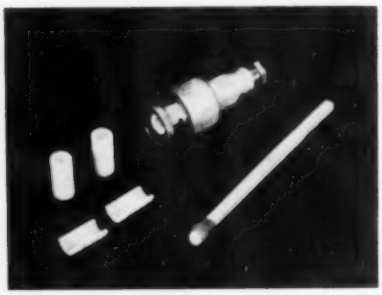
equipment. It has also been designated for use in antennae systems on the 880 commercial jet airliner and some advanced military aircraft.

The TFE is supplied by DuPont.



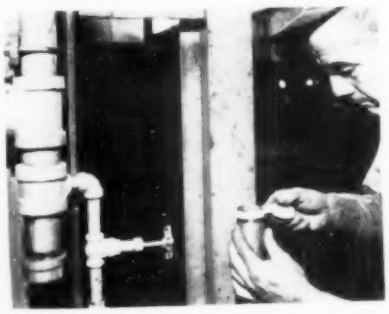
Electrical connectors with Teflon insulators.

Readers' Service Item 46

Teflon Thread Sealant

Permacel Ribbon Dope thread sealant can be used to seal all threaded pipes. This 100% Teflon sealant is claimed to be chemically inert to virtually all acids, gases, and organic solvents, and affected only by molten sodium, fluorine gas, and gaseous chlorine trifluoride.

A compressible solid with an average thickness of four mils, the sealant may be used at continued operating temperatures from —450 to +500° F. It will withstand pressures in excess of 10,000 psi. Because of a low coefficient of friction and non-sticky quality, the material may be applied as an anti-seize. When used on plastic and aluminum pipe, it acts as a self-lubricant. preventing seizing.



Permacel 412 Ribbon Dope thread sealant.

Readers' Service Item 47

High Temperature Insulator

Rogers Corp. is marketing Duroid 5870, a high temperature, glass-Teflon electronic

insulating material, in copper clad sheets and in rods, tubes, and flat sheets. Composed of micro-glass fibers uniformly coated with Teflon, the material was developed primarily for use as high-temperature circuit base stock, missile antenna dielectrics, and microwave strip insulation.

Advantages claimed for the material are close tolerance control, avoidance of "window" effect, elimination of moisture wicking, uniform electrical properties, excellent dimensional stability over wide temperature range, lower cofficient of expansion, and reduced cold flow as compared to Teflon.

Readers' Service Item 48

Dobeckmun Metalshield.

Electrical Shielding Tape

Metalshield, an electrical shielding tape produced by Dobeckmun Co., is said to eliminate intercommunications wire "crosstalk" caused by inductance (leakage of sound from one line to another).

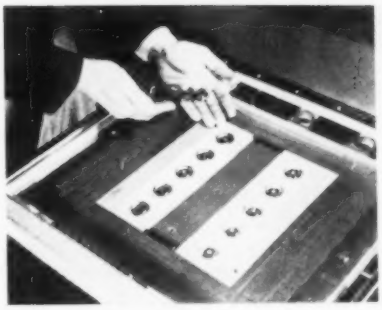
Produced by laminating 0.00035-inch aluminum foil to 0.0005-inch Mylar, the slitted laminate is spiral-wound around two or three wire conductor cables containing a drain wire to make a firm soldered or bolted connection to a ground. Unlike braided copper wire shielding which permits some inductance, Metalshield is a solid wrap.

The material is recommended for use by any industrial or commercial user of intercommunications equipment, especially in aircraft.

Readers' Service Item 49

Acetate Bearing Packages

A new package, developed by Eclipse-Pioneer division of Bendix Aviation Corp., seals bearings individually in a transparent acetate blister with preservative. In contrast to previous multiple-unit packages, in which opening often caused contamination and deterioration, the single package permits each bearing to be individually examined.



Bendix blister bearing packages.

In packaging the bearings, an operator heat-seals a bearing with preservative fluid in a blister of preformed acetate strip with an acetate cover strip and a specially coated lint-free paper board strip for identification.

The packaging machine is manufactured by Packaging Industries, Ltd., and Celanese acetate was used for this application.

Readers' Service Item 50

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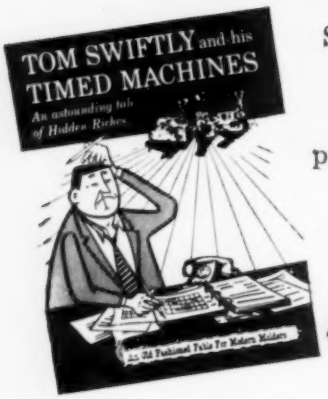

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New Literature

Write item numbers on Readers' Service Card (p. 89) to obtain more information.

"IMS Silicone Sprays." Injecton Molders Supply Co. 4 pages. The catalog lists up-to-date prices on the firm's silicone sprays, including neutralizers and rust preventatives.
Readers' Service Item 61

"Electrical Heating Units and Equipment for Industry." Catalog 60. Edwin L. Wiegand Co. 64 pages. The Chromalox line of electric process heaters are illustrated along with their uses. This includes over 15,000 types of heaters. A technical section on calculating heating requirements is included.
Readers' Service Item 62

"Preplasticizing Injection Molding Machines." Bulletin 5831. Hydraulic Press Mfg. Co. 6 pages. Preplasticizing and its advantages are described, and specifications are listed for five HPM preplasticizing injection molding machines.
Readers' Service Item 63

"Price List for Plexiglas Sheets." Cadillac Plastic & Chemical Co. 16 pages. Prices, quantity discounts, available grades, colors, patterns, and thickness tolerances of Plexiglas cast acrylic sheets and Cadco extruded acrylic sheets are given in this catalog.
Readers' Service Item 64

"Multrathane Urethane Elastomer Potting Compounds." Mobay Chemical Co. 8 pages. Polyester-diisocyanate systems, their physical properties, formulating, handling, and elastomer preparation are described. The same type information is also given for polyether-diisocyanate prepolymers, and an appendix describes the effects of room-temperature and high-temperature storage on these materials.
Readers' Service Item 65

"Disowheel Standards for General Industrial Applications." Disogrin Industries, Inc. 4 pages. This illustrated brochure describes the new Standard polyurethane-tired wheels, along with their superior load-carrying capacity, resilience, abrasion resistance, and tensile strength. Sizes, load capacities, and weights are listed.
Readers' Service Item 66

"Adhesives for Bending Polystyrene to Various Materials of Construction." B. F. Goodrich Co., Adhesives Sales department. 14 pages. Data are given for three adhesive materials: A-827-B, R-1083-T, and 800-X-8002. The first is designed for fused-in-place applications to various base materials; the second, for fusing of pellets to polystyrene sheet or prefoamed polystyrene to various base materials; and the third, the same applications as 1083-T, but with the additional feature of being a water-dispersed product which presents no fire hazard.
Readers' Service Item 67

"Day Three-Roll Dispersion Mills." Bulletin No. 158. J. H. Day Co., division of Cleveland Automatic Machine Co. 4 pages. Descriptions and illustrations are given for several mills, plus detailed information on the Hydraulic Roll Set. The latter uses hydraulic pressure to actuate pistons and thus control roll position and pressure. Such equipment is available optionally on all new Day three-roll mills and as a field conversion kit for the older models.
Readers' Service Item 68

"Chemicals for Resin Emulsions." Union Carbide Chemicals Co. 8 pages. Preparation of the base latex, chemical aids for formulating latex paints, and special chemicals for resin emulsions are described in this bulletin.
Readers' Service Item 69

"Formica Designer's Fact Book." Formica Corp. 206 pages. Over 50 Formica laminate grades are described in this manual, which also contains a comparator chart listing qualities of the more popular grades. Materials are listed, too, by military specification number, plus complete design information on all standard and special grades. Products are illustrated to show their primary function, and other uses; physical and electrical characteristics are given.
Readers' Service Item 70

"Vinylon Fiber." Air Reduction Chemical Co. 5 pages. The material is a synthetic fiber of polyvinyl alcohol. Its properties and processing are described in this bulletin.
Readers' Service Item 71

"A Guide to Fire Extinguishers." Ansul Chemical Co. 6 pages. The folder contains a table which compares characteristics of various fire extinguisher types. A bar graph shows the comparative effectiveness of extinguishing agents according to UL ratings. The firm's dry chemical extinguisher and stored pressure water extinguisher are described and illustrated.
Readers' Service Item 72

"The Richardson Under-Over Indicator." Bulletin 58 B. Richardson Scale Co. 1 page. The item is a panel-mounted meter which gives weighing deviations in terms of dial scale divisions. It is primarily intended for use with the firm's Select-O-Weight automatic proportioning system.
Readers' Service Item 73

"The ABC's of Rust-Lick." Rust-Lick, Inc. 20 pages. Basic information is given on rust, its causes, and application of preventatives. Rust-Lick liquid compounds are described, with their recommended applications and graphic data on the compounds' rust-preventing qualities.
Readers' Service Item 74

"Basic Properties of Aluminum Silicate Pigments." Technical Information No. 1001. Minerals & Chemicals Corp. of America. 4 pages. Basic properties of the firm's line of standard-grade aluminum silicate pigments are given in tabular form, and particle size of each series is depicted graphically. The materials find application in adhesives, plastics, paints, and printing inks.
Readers' Service Item 75

"IMS Catalog of Injection Molding Accessory Plant Equipment." 1959 edition. Injection Molders Supply Co. 58 pages. Equipment listed includes grinders, drum tumblers, mold circulators, chillers, mold releases, gate cutters, clamps, drying ovens, heating cylinders, cylinder purgers, nozzles, and others.
Readers' Service Item 76

"Thin Strip Electric Heating Elements." Acra Electric Corp. Bulletin SHA. 4 pages. Strip heaters from 100° to 1,200° F. are diagrammed. Data included are typical applications, wattages, sizes, and prices.
Readers' Service Item 77

"Pulver-Mill." Sturtevant Mill Co. 2 pages. The bulletin illustrates a vertical impact mill with an integral air classifier, and presents operational information and a flowsheet.
Readers' Service Item 78

Book Reviews

"The Rheology of Elastomers." Edited by P. Mason and N. Wookey. Pergamon Press, 122 E. 55th St., New York 22, N. Y. Cloth, 5½ by 8¾ inches, 202 pages. Price, $8.50.

The proceedings of a conference organized by the British Society of Rheology held at the British Rubber Producers' Association in May 1957, this book is a collection of papers and discussions on various aspects of deformation and flow properties of elastomers.

Most of the papers deal with the kinetic theorty of high elasticity, a theme set by L. R. G. Treloar's introductory paper, "The Present Status of the Theory of Large Elastic Deformations."

A final group of papers is concerned with the elastic and flow properties of some thermoplastics. They include: A. Charlesby and E. Fukada, "Dynamic Visco-elasticity of Polyester Cured by Irradiation;" J. J. Benbow, "The Recovery Behavior of Polythene at Large Strains;" P. L. Clegg, "Elastic Effects in the Extrusion of Polythene;" and E. L. Foster and H. Heap, "High-temperature Tensometry and its Application to Amorphous Polyethylene Terephthalate."

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"Gum Plastics (Rubber-Modified Plastics)." M. S. Thompson. Reinhold Publishing Corp., 430 Park Ave., New York 22, N.Y. Cloth, 5 by 7½ inches, 193 pages. Price, $4.50.

Gum plastics comprise a class of elastomeric compounds copolymerized with resins, represented by such compounds as ABS, impact-type polystyrene, and impact-type, rigid PVC. Offering toughness in addition to the properties of their unmodified resins, gum plastics have been finding more frequent and increasingly important industrial and commercial applications. Improvements in mechanical strength, shock resistance, heat distortion resistance, gloss and finish, molding characteristics, and visual and tactual appeal have contributed to the materials' increased popularity.

While gum plastics may be processed by most of the common procedures, they are especially adaptable for machining, providing that conditions for minimizing frictional heat build-up are maintained.

Insulating properties of impact-type polystyrene make it very useful in manufacturing refrigerator components. Other appliances, such as housewares, utilize gum plastics for their serviceability, low cost, ease of fabricating intricate shapes, and eye-appeal. The application of gum plastics which best demonstrates their outstanding advantages is pipe, in which field they vie for a major position. In addition to fulfilling requirements, such as strength and durability, plastics also provide low cost, joining and handling simplicity, and reusability.

"Inorganic Fibres." C. Z. Carroll-Porczynski. Academic Press, Inc., 111 Fifth Ave., New York 3, N. Y. Cloth 5½ by 8¾ inches, 353 pages. Price, $11.00.

Of the many inorganic fibres, only two are in common use in the plastics industry: glass as a reinforcer, and asbestos as a reinforcer or filler. The author has devoted a chapter to the contributions of these fibres to plastics.

Glass, in the form of cloth, woven roving, mats, roving, molding compounds, or chopped strands, is added to resins before molding or spraying. The finished materials, characterized by excellent strength/weight ratios and impact resistance in addition to the properties of the unmodified resin, may be used in such products as aircraft and automotive parts and bodies; molded boat shells; architectural panels; pipes, ducts, and tubes; and household appliances.

Asbestos is not only a low-cost filler, but contributes, among other characteristics, heat and flame resistance, decreased mold shrinkage, improved dimensional stability, and thermal insulation. While it is extremely important in the processing of thermosetting plastics, which depend upon fillers, its use in conjunction with thermoplastics is largely confined to tiles and sheets for floor coverings.

"The Hydrostatic Pressure Effect on Polymer Melt Viscosity." B. Maxwell and A. Jung for Department of Army. Order PB 151232 from OTS, U. S. Department of Commerce, Washington 25, D. C. Paper, 25 pages. Price, 75¢.

The apparent viscosity of polymer melts subjected to controlled hydrostatic pressures independent of the driving force was measured. Hydrostatic pressure caused a marked increase in the apparent viscosity of polystyrene and polyethylene. The viscosity of polystyrene melts increased 135-fold at 18,000 psi hydrostatic pressure, and that of polyethylene, 14-fold at 24,000 psi. Thus, the practice of increasing molding or extruding pressure to increase the flow rate of the melt may be self-defeating. For example, increasing the injection molding pressure on polystyrene may cause such a large increase in viscosity that net increase in flow rate would not be worth the expense of equipment required to achieve the higher pressure.

"Modern Chemical Processes—Volume 5." Walter J. Murphy, Editorial Director. Reinhold Publishing Corp., 430 Park Ave., New York 22, N. Y. Cloth, 8½ by 11½ inches, 154 pages. Price, $6.00.

Fourteen recently developed chemical engineering processes are described. Each process discussion starts with background information concerning commercial and technical history, origin of present installation, and proceeds to plant installation, process and operation of plant, economics of process, plant investment and amortization, personnel, and future prospects. Methods of operation and equipment are clarified by profuse photographic and diagrammatic illustration. The book may be valuable as a guide for other chemical engineering problems.

"Dielectric Materials Moisture Resistance Study: Final Report." J. J. Chapman and L. J. Frisco, Johns Hopkins University for Bureau of Ships, U. S. Navy. Order PB 151014 from OTS, U. S. Department of Commerce, Washington 25, D. C. Paper, 76 pages. Price, $2.00.

The physical and electrical properties of polyethylene and polytetrafluoroethylene were virtually unaffected by long exposure to tropical humid atmosphere. Most of the other materials tested (polystyrene, monochlorotrifluorethlene polytetrafluoroethylene-glass laminate, glass silicone laminate, glass bonded mica, mica-filled phthalate resin, mineral-filled diallyl phthalate resin, and cellulose-filled melamine resin) showed degradative effects which were attributed, in most cases, to moisture absorption. Specific effects for each material are given.

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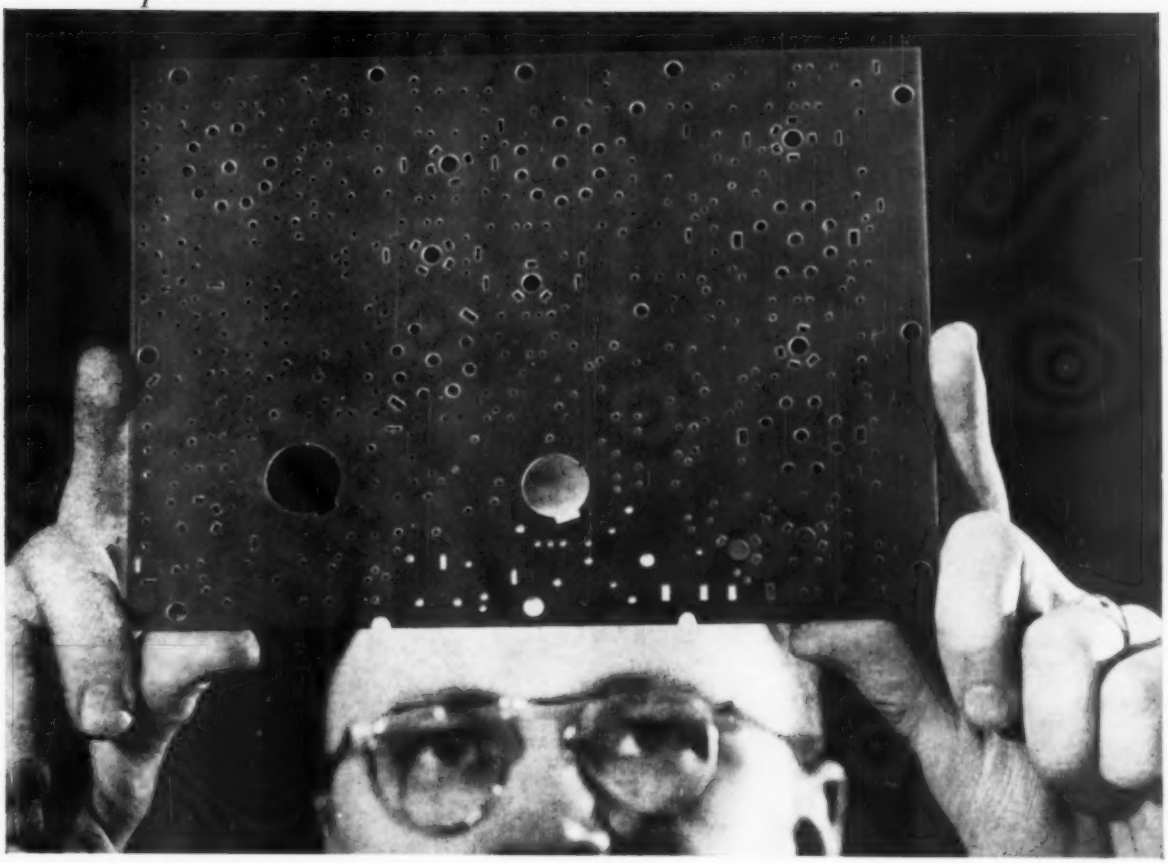

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Abstracts of Important Articles

Materials

"Study of Polymerization of Unsaturated Polyesters by Calorimetry," H. Streitzing, *Ind. Plastiques Mod.*, 10, 10, 39 (Dec. 1958).

The calorimetric method and apparatus for studying polymerization of unsaturated polyesters described permits: (1). determination of the amounts of peroxide and accelerator required for hardening a given polyester at a given temperature; (2). determination of the amounts of monomer to be added for complete copolymerization; (3). comparison of the peroxides; and (4). measurements of rates of copolymerization. The method is easy to apply, and the apparatus simple. (In French.)

"Accelerated Aging of Some Thermoplastics," J. A. Kaird, *Brit. Plastics*, 32, 1, 32 (Jan. 1959).

Results are reported of investigations on the aging characteristics of toughened polystyrene, high- and low-density polyethylene, and polyvinylidene chloride when exposed to natural and accelerated ultraviolet light and heat, as revealed by tensile, elongation, and impact tests. The relation of color to aging properties also was considered.

"Rilsan: New Polyamide Resin for Injection Molding and Extrusion," E. Crosio, *Poliplasti*, 6, 27, 60 (May-June 1958).

The French polyamide, Rilsan, is now also being produced in Italy. The properties of the material and special precautions to be taken in processing it by injection molding and extrusion are described. (In Italian.)

"Reinforcement Effects in Laminates," W. Spath, *Gummi u. Asbest*, 11, 3, 124; 11, 4, 194 (March & April 1958).

With the aid of simple model concepts, the behavior of reinforced plastics is discussed, particularly the relation of strength of glass-reinforced laminates to glass content, and the effect of the internal stresses between glass and resin on thermal measurements. The theoretical deductions arrived at are checked against results of practical tests described in the recent literature. (In German.)

"Self-Extinguishing Polyester Resins," B. Parkyn, *Brit. Plastics*, 32, 1, 29 (Jan. 1959).

All polyester resins are combustible, but they can be rendered self-extinguishing by the use of suitable additives and chemical modification, including combination of organo-metal compounds with the resin. These methods are outlined, the limitations of the resulting self-extinguishing resins pointed out, and fire-extinguishing tests are described.

"Synthesis of Polyphenylethyl by Polycondensation of 1,2-Dichloroethane with Benzene," I. V. Nicolescu and M. Iovu, *Ind. Plastiques Mod.*, 10, 10, 46 (Dec. 1958).

As a result of polycondensation reactions of benzene with dichloroethane and with an alkyl-aluminum halide catalyst, products were obtained at the University of Bucharest, Rumania, which were more soluble in benzene than when aluminum chloride was the catalyst. The chief function of the organo-aluminum catalysts thus appears to be that of more selective orientation of the polycondensation reaction toward the para position, while at the same time reducing the tendency to form auxiliary linkages. (In French.)

"Sealability of Polyethylene Films," J. M. McKelvey and T. H. Strome, *Modern Plastics*, 36, 10, 107 (June 1959).

A basic study of heat-conductive sealing shows two mechanisms of sealing.

"Isophthalic Polyesters," E. E. Parker, *Modern Plastics*, 36, 10, 135 (June 1959).

The preparation, properties, and applications of the resins are described.

"Microscopic Study of Expandable Polystyrene Bead, Prepuff, and Foam," Ruth Giuffria, *Modern Plastics*, 36, 10, 150 (June 1959).

A description of the study that led to the technique for producing thin cross-sections of expanded bead foam.

"Polyvinyl Fluoride Film," V. L. Simril and B. A. Curry, *Modern Plastics*, 36, 121 (July 1959).

Teslar PVF film properties are described.

"Pink Discoloration of Vinyls," T. A. Girard and C. F. Koda, *Modern Plastics*, 36, 10, 148 (June 1959).

The causes and preventions of the problem are discussed.

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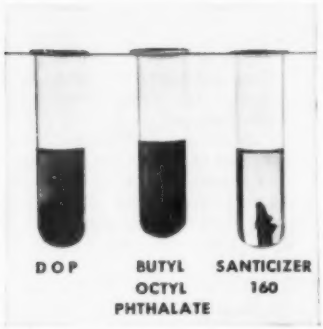
Santicizer 160 gives you... IMPROVED PROPERTIES IN TILE



SANTICIZER 160 shows low migration to asphalt by insignificant pickup of black color from asphalt-impregnated felt, can prevent buckling of tile by migration to adhesive.

Staining tests show that SANTICIZER 160 provides best resistance to asphalt staining and the other big troublemakers like mustard, catsup, lipstick, tar, and kitchen grease.

If you want to stop customer complaints about staining, loss of adhesion, and buckling of tile by plasticizer migration to adhesive, use SANTICIZER 160. Even if your own adhesive works satisfactorily, you can't be sure a customer will use *your* adhesive with *your* tile. When you use SANTICIZER 160, you'll also boost consumer acceptance with these added benefits:

"Three-dimensional" gloss • High abrasion resistance • Excellent dimensional stability • Good resistance to extraction and hydrolysis

FASTER, MORE ECONOMICAL PROCESSING

	PROCESSIBILITY			FILLER TOLERANCE					
Plasticizers	Time to reach 280° F.	Plasticity on roll mill	Tack	Plasticity with fillers (parts filler) 100	115	125	Tack with fillers (parts filler) 100	115	125
SANTICIZER 160	2 min., 3 sec.	E	E	E	G	F	E	G	F
DOP	2 min., 35 sec.	VG	G	VG	F to P	*	G	F to P	*
BUTYL OCTYL PHTHALATE (SANTICIZER 165)	2 min., 15 sec.	E	G	E	F	P	G	F	F

E—Excellent, VG—Very Good, G—Good, F—Fair, P—Poor. *Batch dropped from mill. Formulation available on request.

Step up production and cut down processing delays with SANTICIZER 160. Compare its advantages in processing with any other plasticizer...none can match these important benefits:

HIGH WETTING ACTION—allows higher filler use with homogeneous mixtures and best gloss

GOOD PLASTICITY AND FAST FUSION—for fastest processing

QUICK TACK—for easy milling, surface gloss, and roll retention (no fall-off)

UNIFORM RESULTS—for "leveling out" the effect of variations in processing

ATTRACTIVE COST THROUGH BULK OR BLEND PURCHASE

The many advantages of SANTICIZER 160 make it your best buy in floor-tile plasticizers. If your formulation calls for a plasticizer blend (such as SANTICIZER 160 with DOP, DIDP, or SANTICIZER 165), Monsanto *custom blends* in bulk offer you these important advantages:

- You can reduce ordering, handling, storage, and blending expenses
- You achieve standard, uniform mixtures and eliminate chances of weighing errors, contamination, spillage
- You obtain the lowest bulk price on ingredients

Conserve your working capital by blend service from Monsanto. Monsanto stocks floor-tile plasticizers at *six* bulk stations, *13* warehouses, and *two* plants. They're located for fast delivery to your plant.

For more information or a SANTICIZER 160 sample, contact your Monsanto representative.

For information on custom blends or a technical evaluation of your formulation, write:

"Plasticizer Council"
Monsanto Chemical Company
Organic Chemicals Division
Dept. PL-4, St. Louis 66, Mo.

Monsanto

SANTICIZER: Monsanto T. M. Reg. U. S. Pat. Off.

ONLY SANTICIZER 160 GIVES YOU ALL THESE ADVANTAGES IN VINYL FLOOR TILE

"Stabilization of Vinyl Chloride Polymers," G. Bonfiglio, *Mat. Plastiche*, 24, 4, 365 (April 1958).

Brief review of stabilizers for vinyl chloride polymers, with the aim of explaining their uses and the factors influencing the selection of different types for different purposes. (In Italian.)

"Phenolic Resins in Rubber Compositions," E. G. Curphey, *Plastics (London)*, 23, 255, 265 (Dec. 1958).

The role of phenolic resins in natural and synthetic rubbers has been suggested to be that of curing agent, colloidal filler, or tackifier. The mechanisms proposed by individual investigators in support of their theories are examined.

"Molecular Determinations of Vinyl chloride/Vinyl acetate Copolymers," G. Ciampi and G. C. Bizzari, *Mat. Plastiche*, 24, 4, 319 (April 1958.)

Osmometry was used to determine molecular weights of a series of non-fractionated copolymers of vinyl chloride and vinyl acetate. The values thus obtained were then related to viscometric parameters usually employed to define molecular state of the copolymers. The method, results obtained, and possibilities opened up are considered. (In Italian.)

"Atomic Radiations on High Polymers," A. Coen, *Mat. Plastiche*, 24, 4, 302, (April 1958).

This detailed review is divided into three parts, the first of which discusses the different types of radiations employed, their efficiency, the processes they induce, and the structural changes that take place in an irradiated polymer. How these changes influence physical and chemical properties is shown in Part II, while Part III deals with the effects on the properties of a number of synthetic resins, as well as on some elastomers and synthetic fibers. (In Italian.)

"Thermal Effects During the Stretching of High Polymers," F. H. Muller, *Kunststoffe*, 49, 2, 67, (Feb. 1959).

The limitations of methods used so far in studying thermal effects of deformation of high polymers led to experiments on the direct determination, by calorimetric means, of heat changes occurring during deformations. The principles are outlined of the sensitive "stretch calorimeter" designed for the work, and tests are described on steel, rubber, and plastics in both reversible and irreversible deformations. New light is thrown on the hitherto misunderstood or hard-to-explain relationships of deformability in size and shape of the specimen cross-section, and the known influence of various heat conductivity conditions are made clearer. (In German.)

Equipment

"Calculations of Dimensions of Molds for Compression Molding of Thermosetting Resins," M. Sirtoli, *Mat. Plastiche*, 24, 4, 328 (April 1958).

The author discusses factors, including type of material, pressures, shapes and final dimensions, that are to be considered in designing molds of the right dimension for use in compression molding of thermoset resins. He develops equations for the necessary calculations and shows, by an example, how these are applied. (In Italian.)

"Internal Mixer for Thermoplastic Compounds," H. Ennulat and M. Hurler, *Kunststoffe*, 49, 1, 18 (Jan. 1959).

Construction and mode of operation are described of a new type of internal mixer of German design. Details are given of the performance of a machine of this kind tested under normal production conditions in a large, well-known factory. (In German.)

Requests for copies, reprints, or further information on any article abstracted in this department should be addressed to the publisher of the magazine where the article appeared. The publishers and their addresses are given below:

"Applied Plastics"
The Scientific Press, Ltd.
11 Gloucester Road
London, S.W. 7, England

"ASTM Bulletin"
American Society for Testing Materials
1916 Race St., Philadelphia 3, Pa.

"Australian Plastics"
Australian Trade Publications, Ltd.
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341 Church St., Toronto, Ont., Canada

"Chemical and Engineering News"
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Washington 6, D.C.

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A. W. Gentner-Verlag
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Stuttgart, W. Germany

"Hule Mexicano y Plasticos"
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Washington 6, D.C.

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Les Publications Techniques Associees
40 Rue du Colisee, Paris 8e, France

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Carl Hanser Verlag
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Borgfelder Strasse 83, Hamburg 26,
Germany

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Reinhold Publishing Corp.
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Via Farneti 8, Milan, Italy

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Galerie du Center, Bloc 3
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Aegidiengasse 5, Vienna 6, Austria

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Veb Verlag Technik
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Danish Technical Press
31 Vester Farimogsgade
Copenhagen 5, Denmark

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Kunststoffeninstituut T.N.O.
Julianalaan 134, Delft, The Netherlands

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Bowling Green Lane, London E.C.I.
England

"Plastics World"
Cleworth Publishing Co., Inc.
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Paris 9e, France

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G.P.O. Sydney, Australia

"Revista de Plastios"
Inst. "Alonso Barba"
Serrano 119, Madrid, Spain

"Revue Générale des Matiéres Plastiques"
196 Ave. Jean-Jaures, Paris 19e, France

"Rubber and Plastics Age"
Rubber and Technical Press, Ltd.
Tenterden, Kent, England

"SPE Journal"
65 Prospect St., Stamford, Conn.

"Spectator"
Published by New England Chapter
Society of Plastics Engineers, Inc.
Somers, Conn.

"Transactions of the Plastics Institute"
6 Mandeville Place, London W.I.
England

Western Plastics
Western Business Publications
274 Brannan Street
San Francisco 7, Calif.

"Model Laws for Single-Screw Extruders for Plastics," G. Schenkel, *Kunststoffe*, 49, 1, 15; 49, 2, 63; 49, 3, 121 (Jan., Feb., & March 1959).

The Model problem for the design and operation of single screw extruders and the discrepancy between existing model laws and results obtained in practice are critically examined, especially the rules for determining depth, length of screw and rate of rotation. The importance is stressed when formulating a law, of first dealing with each of the two main zones of the screw separately, before studying the peculiarities of the unit as a whole, and model laws for the individual zones are proposed based on equations for temperature increase as a function of dimensional and processing variables. Finally a complete solution for the screw as a functional unit is offered and examples show how the proposed laws work in practice. (In German).

"VHF Preheating for Thermosetting Molding," J. F. Trembley, *SPE J.*, 15, 7, 543 (July 1959).

A description of VHF preheating, and how it can reduce molding cycle time.

"New Developments in Molding and Extrusion Equipment," R. R. Moyer, *Western Plastics* 6, 8, 17 (Aug. 1959).

A brief review of developments introduced last year or early this year.

"Improved Instrumentation for Screw Extruders," E. C. Bernhardt, W. G. Bohres, W. M. Edwards and P. H. Squires, *SPE J.*, 15, 8, 735 (Aug. 1959).

A new and accurate temperature- and pressure-sensing device is described.

General

"Causes of Defects in Processing Glass-Reinforced Plastics," H. Kalpers, *Plastverarbeiter*, 9, 4, 134 (April 1958).

The causes of numerous defects, such as bubbles, crazing, odors, pits, warping, local excess or deficiency of resin, or shifting of glass fibers, are briefly described and methods of avoiding them are suggested. (In German.)

"East German Research into Plastics," M. Kaufman, *Plastics (London)*, 23, 255, 439 (Dec. 1958).

In this installment, the author, recently returned from a tour of the East German plastics industry, deals with the plastics research carried out in an Institute in Leipzig and in another in East Berlin.

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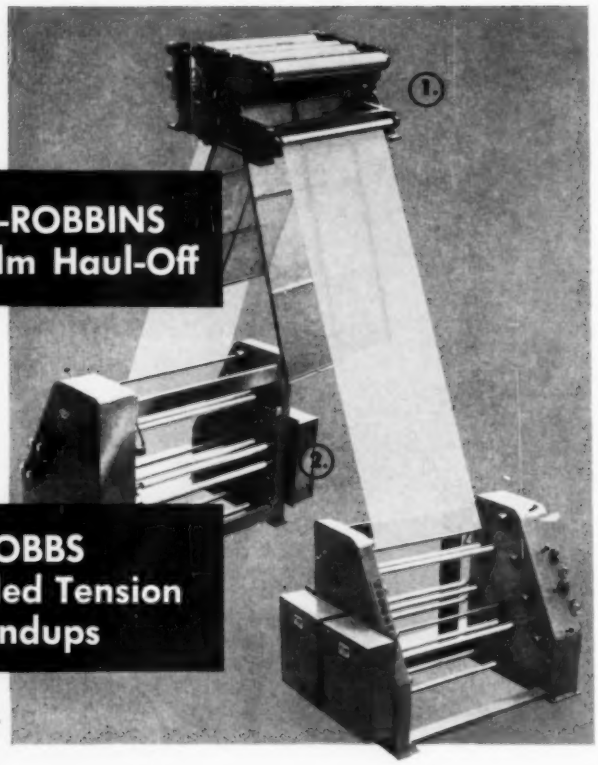

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The best of plastic film can be ruined by poor winding. Lynch-Robbins recommends Hobbs winding equipment as a "follow through on quality" with their installations.

More and more original equipment manufacturers are recommending or adopting Hobbs Winders for use with their equipment. Not only is this because Hobbs Winders accurately control tension, but also because Hobbs can engineer the winder design to fit the particular job, thus giving "more winding for the money". Lynch-Robbins is one of a growing number of leading original equipment manufacturers who are selecting Hobbs to design their winding equipment.

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Patent Digest

Equipment

Apparatus for Injection Molding Plastic Articles. No. 2,865,051. G. A. de Mattia, Nutley, and M. P. de Mattia, Passaic, N. J.

Thin-walled articles are manufactured by means of a plunger which forces the resin out of the hopper into the molding cavity.

Valved Gate for an Injection Molding Press. No. 2,865,050. W. Strauss, Philadelphia, Pa., (to F. J. Stokes Corp., Philadelphia, Pa.).

A tapered pin valve member has a pin projecting from the narrower portion. A plurality of flats extend lengthwise for the remainder of the pin valve.

Applications

Floating Plastic Screen. No. 2,867,346. A. Champagnat, Paris, France (to British Petroleum Co., Ltd., London, England).

A flexible plastic storage vessel for volatile liquids has an upright wall and fixed roof. The liquid is protected from evaporation by a blanket suspended above the surface by a series of small, contiguous, cellular, float units. An apron attached to the blanket helps to maintain a ring of vapor in equilibrium with the liquid between the blanket and the surface of the liquid, thus further restricting evaporation.

Molded Plastic Articles such as Outlet Boxes. No. 2,867,349. W. M. Parker, Jr., Parkersburg, W. Va. (to Union Insulating Co., Inc., Parkersburg, W. Va.).

Intended to be used as an outlet or junction box, this rigid plastic open face box is adapted to be supported from an unfinished wall with its open outer face adjacent to the area to be plastered. A thin flash of the plastic temporarily closes the screw receiving end of the screw hole to protect the threads from plaster.

Display Box for Watches, Etc. No. 2,867,353. A. R. Botham, New York, N. Y. (to Arrow Mfg. Co., Inc., West New York, N. J.).

The lid consists of two plastic compositions having different transparencies; the inner concave portion transparent, and the outer, opaque. This pivotally-hinged lid thus provides a background for the contents of the opened box.

Plastic Blades, Particularly for a Compressor Rotor of a Gas Turbine Engine. No. 2,868,441. Z. Reutt, Coventry, England (to Armstrong Siddeley Motors Ltd., Coventry, England).

The blade of a gas turbine engine compressor is formed of synthetic, resin-impregnated, cloth laminations.

Positions Open

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Expanding Chemical Company requires a Chemist or Production Man completely familiar with every stage of Urea and Melamine Molding Powders production from the basic resin through to the finished powder. Location: Metropolitan New York area. Excellent opportunity for top man to participate on a profit-sharing basis with new producer of molding powders. Please give complete details of experience in first letter.

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1 time	$19.00 per inch
6 times	$18.00 per inch
12 times	$15.00 per inch

For sale due to closing of General Electrics plastics department—two (2) 200-oz. Jackson-Church vertical injection molding presses. Good condition. Equipped with 6" extruders as preplasticizing units. Clamping force—1200 tons, maximum stroke 42", maximum daylight 60", clearance between stress rod 48"—L to R and F to B, maximum injection pressure 10,000 psi platen size 77" x 77" high speed closing and opening with Vickers hydraulic units. Minimum floor space requirements. Ideally suited for large part molding such as cabinets, furniture drawers, etc.

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Used injection molding machines, ovens, granulators. One machine or complete plant.

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Ovens, Grinders, Powder Mixers, Injection Molding Machines 1 oz. to 60 ozs. never used and used, Two-head Bottle Blowing Machines, Extruders, granulators and refrigeration systems.

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Current Market Prices

Price Changes and Additions

Adhesives			
Hapex 1230, 1235	lb.	$2.00 /	$4.00
Catalysts			
Hapex 1201	lb.	1.15 /	2.00
1210	lb.	1.50 /	3.10
1213	lb.	1.30 /	2.00
1218	lb.	1.50 /	3.00
1221	lb.	1.05 /	2.00
Haphen 1101A	lb.	.46 /	1.40
1106	lb.	2.00 /	1.00
1108A	lb.	2.00 /	.75
Glass Reinforcements			
Hastings boat and tooling fabrics 1500X	yd.	.66 /	1.24
1520X	yd.	.63 /	1.18
1532X	yd.	.55 /	1.02
1533X	yd.	.49 /	.92
1534	yd.	.83 /	1.57
1544	yd.	1.16 /	2.18
1587	yd.	1.38 /	2.63
Production cloth, volan A finish	yd.	.76 /	2.96
Glass tape	yd.	.06 /	.375
Woven roving (Garan finish) 175	lb.	.72 /	1.00
HMR-29	lb.	.75 /	1.05
Milled fibers	lb.	.60 /	.80
Cordage	lb.	1.75 /	2.50
Rope	lb.	1.25 /	1.75
Miscellaneous			
Ethyl antioxidants 702	lb.	.84 /	1.07
720, 736	lb.	2.00 /	2.00
Release agents:			
Hastings 1908	lb.	.60 /	1.50
Moldkote 1906	gal.	16.00 /	3.80
1907	gal.	32.00 /	25.80
Plasticizers			
Adipol BCA	lb.	.45 /	.475
KP-23	lb.	.325 /	.335
Kronisol	lb.	.34 /	.375
Elastex 36R	lb.	.4325 /	.4675
37R	lb.	.50 /	.515

Resins & Molding Compounds			
Epoxy			
Hapex 1200A	lb.	.715 /	2.00
1231	lb.	1.90 /	4.00
1288	lb.	.68 /	1.60
1289, 1290, 1292	lb.	.65 /	1.60
Phenolic			
Haphen 1100	lb.	.46 /	1.40
1104	lb.	.93 /	4.00
1105, 1107	lb.	.65 /	2.25
Polyamide			
Zytel 101 natural	lb.	1.18 /	1.35
101 white, 105 black	lb.	1.25 /	1.45
101 colors	lb.	1.37 /	1.65
Polyethylene			
Marlex 5003, 5005, 5012, 6002, 6009, 6015 Natural	lb.	.38 /	.42
Plain colors and high dispersion black	lb.	.44 /	1.01
General purpose black	lb.	.405 /	.445
5040, 5065, 6050, natural	lb.	.35 /	.39
Plain colors and high dispersion black	lb.	.41 /	.98
TR-101	lb.	.40 /	.44
201	lb.	.44 /	.48
212, 213	lb.	.38 /	.42
Vinyl			
Escambia general purpose PVC, electrical grade PVC, PVC pearls	lb.	.235 /	.435
Solvents			
Moldkote 1905	gal.	16.00 /	1.75

CALENDAR of COMING EVENTS

October 28-30

Society of Aircraft Materials and Process Engineers. Symposium on Sealants and Sealing of Aircraft, Missiles, and Electrical Components. Institute of Aeronautical Sciences, Los Angeles, Calif.

November 2-5

AIME Metallurgical Society Technical Committee on Chemistry and Physics of Metals. Fall Meeting: Symposium on Plastics and Ceramics. Morrison Hotel, Chicago, Ill.

November 4

SPE St. Louis Section RETEC. Plastics in the Shoe Industry. Statler Hotel, St. Louis, Mo.

November 8-10

Toy Production Show (originally scheduled for April 14-16). New York Trade Show Building, New York, N. Y.

November 16-19

National Academy of Sciences-National Research Council. Building Research Institute: Sandwich Panel Design Criteria. Shoreham Hotel, Washington, D. C.

November 19

SPE Golden Gate Section RETEC. Plastics in Packaging. Claremont Hotel, Berkeley, Calif.

November 19-20

Plastics Institute. The Influence of Plastics in Building. Royal Institute of British Architects, London, England.

December 1-3

U. S. Army Signal Research and Development Laboratory. Wire and Cable Symposium. Berkeley-Carteret Hotel, Asbury Park, N. J.

January 12-15

SPE Chicago Section ANTEC. Conrad Hilton Hotel, Chicago, Ill.

January 26-27

Society of Vacuum Coaters. Biltmore Hotel, New York, N. Y.

February 2-4

SPI Reinforced Plastics Division Conference. Edgewater Beach Hotel, Chicago, Ill.

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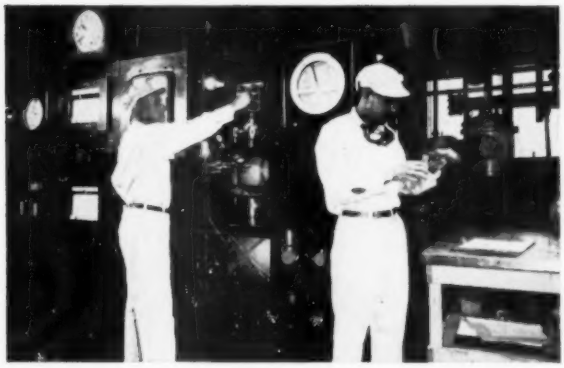

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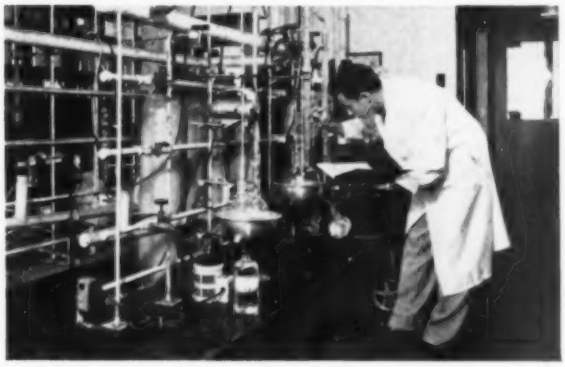

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...and constant, imaginative research to bring you better products at lower cost

Pittsburgh Industrial Chemicals

Phthalic Anhydride • Maleic Anhydride
Fumaric Acid • Plasticizers (Phthalates, Adipates, Sebacates, Epoxies)
Ortho Cresol • Meta Para Cresol • Xylenol
Pyridine • Oleum
Phenol • Sulphuric Acid • Phthalocyanines

COAL CHEMICALS • PLASTICIZERS • PROTECTIVE COATINGS • ACTIVATED CARBON • COKE • CEMENT • PIG IRON • FERROMANGANESE

NEW DESIGNS IN MARLEX

Molded by
Baxter Company,
Cincinnati, Ohio

New G. E. X-Ray Darkroom Light has housing made of heat-resistant MARLEX*

This new General Electric Ceiling Safelight is designed to give the proper illumination for fluoroscopic rooms and for handling photosensitive materials in X-ray darkrooms.

G. E. specifications called for a rugged, opaque, molded plastic housing that would be unbreakable and corrosion-proof. It also had to meet Underwriters' approval. G. E. design engineers found that MARLEX rigid polyethylene is the least expensive quality thermoplastic that meets *all* requirements!

One of the important features of MARLEX for this application is its precision moldability. The tinted acrylic lens has to snap into place for a light-tight friction fit, and injection moldings of MARLEX can be held to the close tolerance required.

No other type of material serves so well and so economically in so many different applications. How can MARLEX serve you?

*MARLEX is a trademark for Phillips family of olefin polymers.

PHILLIPS CHEMICAL COMPANY, Bartlesville, Oklahoma, A subsidiary of Phillips Petroleum Company

PLASTICS DIVISION OFFICES

NEW ENGLAND	NEW YORK	AKRON	CHICAGO	WESTERN	SOUTHERN	EXPORT
322 Waterman Avenue	80 Broadway, Suite 4300	318 Water Street	111 S. York Street	317 N. Lake Ave.	6010 Sherry Lane	80 Broadway, Suite 2800,
East Providence 14, R.I.	New York 5, N. Y.	Akron 8, Ohio	Elmhurst, Ill.	Pasadena, Calif.	Dallas 25, Texas	New York 5, N. Y.
GEneva 4-7600	Digby 4-3480	FRanklin 6-4126	TErrace 4-6600	MUrray 1-6997	EMerson 8-1358	Digby 4-3480

MARLEX